ARITHMETICAL ESSENTIALS

BOOK THREE

DRUSHEL-NOONAN-WITHERS

LYONS AND CARNAHAN

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BY

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LYONS AND CARNAHAN

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HELPS AND SUGGESTIONS TO TEACHERS

Provision for Pupils of Varying Ability

This book is intended to provide the largest possible opportunity for self instruction for children of the seventh and eighth grades. Sufficient material is provided for the superior pupils of the class. The teacher should be the judge of how much the slower children can accomplish.

Computing Skill

This text provides abundant practice in computation for children in the upper grades: first, through a series of timed practice exercises in each year; second, through the use of statistics in table form; third, through the application of short methods. See Chapter II, pp. 13-19; Chapter V, pp. 32-41; and Chapter VI, pp. 42-50 (Part 1) for examples of each of these types.

The tests listed on pages 297 and 299 provide standardized material which teachers should use frequently during the eighth year to measure their classes. 100% accuracy with reasonable speed should be the aim in these computing exercises. Answers to examples are omitted from this book to emphasize the need of checking computations.

Certain 4 minute, 6 minute and 8 minute tests in the fundamental processes with integers are standardized against the corresponding Courtis Research Tests, Series B. This enables the teacher to use the Courtis Standards in these tests. The standards stated in all other exercises have been derived from enough cases to insure their validity.

Short Methods

It is not intended that children should memorize all the short forms in the chapter, **Saving Time in Computing.** The short

processes that seem most suitable for individual classes should be selected by each teacher for special emphasis. Using short methods should be encouraged whenever possible because it decreases the chances of error and saves time. Children who wish to develop special computing skill will find it valuable to do all the work in the chapter named.

Problems

The problem material of this book aims to give pupils an acquaintance with civic, social and business practices.

Three methods of showing the reasoning in a problem are suggested; the graphic form, the table form, and the equation form.

In the computing part of a problem pupils are encouraged to take the shortest road to the answer and to be certain that the answer is right. Pupils should decide for themselves whether or not their skill in computing demands the use of a pencil.

The Use of Graphs

A full discussion of graphs as instruments or tools to be used in making number relations obvious is presented early in the seventh year in order to give pupils ample time to acquire proficiency in a method, which has frequent application in ordinary reading and in everyday business. Pupils should be encouraged to collect local material to be used in constructing graphs, to graph results of their school activities, and to bring to class from their outside reading what they consider to be unusually good examples of graphs.

Square Root

In the extraction of square root the method of approximation by long division is employed in this text because this method is readily rationalized and easily remembered. This method requires the pupil to know division of integers and of decimals, and the meaning of a square root.

Metric System

It is intended to give a reading knowledge of the more common units of measure (meter, millimeter, gram, and liter) incidentally in connection with problem solving.

The more common metric tables are placed in the latter part of the book in parallel with the corresponding English tables as an aid to the teacher in case she wishes to teach metric units more intensively than is provided for in the text.

Organization

Organization of material is not only an essential element in the learning process, but it also is a necessary factor in one's ability to use what has been learned.

The material of this book is organized for the supervisor, the teacher, and the learner. The chapter titles indicate to the supervisor the order of development that is intended for the course. The chapter analysis as shown in the table of contents should guide the teacher in the presentation of the different topics. The development of the topic in the text is for the learner.

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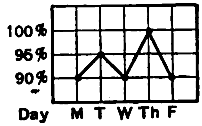
ARITHMETICAL ESSENTIALS

BOOK THREE

PART I—SEVENTH YEAR

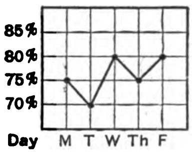
CHAPTER I

USING GRAPHS IN PROBLEM SOLVING



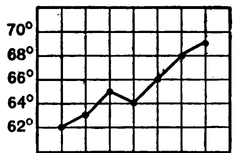
1. This chart shows in % the attendance record of a 7th grade class for a week. Read it.

2. Make the chart which shows this attendance record for a week: 90%, 100%, 95%, 90%, 85%.



3. This chart shows John's daily marks in arithmetic for a week. Read it.

4. Mary's weekly spelling marks for 10 weeks were as follows: 75%, 85%, 95%, 90%, 90%, 75%, 90%, 95%, 85%, 95%. Make a chart which shows this record.

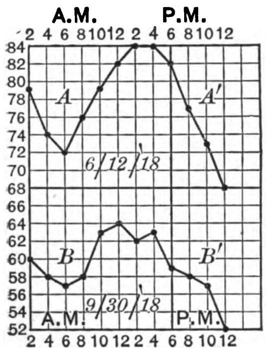


5. This chart shows the daily temperature at 7 A.M. for a week. Read it.

6. Construct the chart for these daily temperatures at 9 A.M.: 70°, 72°, 74°, 73°, 70°, 71°, 75°.

The lines in the charts on this page are called graphs. Graphs are used in problem solving when we wish to show the results in a striking way.

Reading Line Graphs



This kind of graph is often used when we wish to show how temperature changes during the day, how population changes in a given time, what progress is made in one's study during the term of school, etc.

In the illustration the horizontal line represents the day divided into two-hour periods. In the vertical line each unit represents 2 degrees of temperature.

Graph *A* shows the changes of temperature for June 12, 1918. Graph *B* shows the changes for September 30, 1918.

1. What was the hottest hour of each day? The coolest?

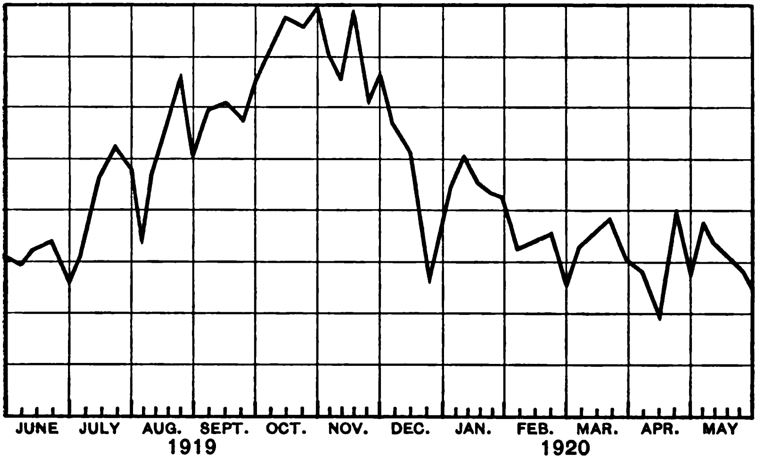
2. Which day had the greatest change in temperature? How many degrees?

3. Which day had the same temperature for two hours? At what time?

4. What might account for the drop in temperature before 2 P.M. in the September 30 curve?

5. Judging from the direction of the graphs at midnight of June 12 and September 30, what would you say was the temperature of the early morning hours of June 13 and October 1 compared with the same hours of June 12 and September 30?

6. Find in your daily paper the record of temperature for a day and construct the graph.



WEEKLY CATTLE RECEIPTS AT SEVEN MARKETS

This graph shows the number and the changes in cattle receipts from week to week at seven important cattle markets from June, 1919, to the end of May, 1920. Each unit of the vertical line stands for 50,000 head of cattle. The graph is read as follows: "The total receipts of the seven markets at the end of the first week in June were 150,000 head; for the second week, 160,000 head; for the third week, 170,000 head, etc." What were the receipts for the 4th week in June?

1. Read the graph for April, for Dec., for May.

2. What were the receipts for the 4th week in July? for the 5th week in Aug.? for the 4th week in March?

3. Study the graph to discover how it is made.

(1) Draw a chart like this one, omitting the graph.

(2) Place the proper number at both ends of each

horizontal line. For the first line from the bottom, this number is 50,000. What is it for the second line?

(3) For each week in the year place a dot in your chart, so that it will show the number of cattle received for that week.

(4) Connect the dots. If you have done your work right, you have a better line graph than the one shown on the previous page. Why?

4. How would you find the total receipts for a month from your graph? Do it for December.

5. Find the total receipts for the first six months in your graph. Find them for the last six months.

6. Make and solve another problem from your graph.

7. This table shows the monthly change at Chicago in the price of flour per barrel during 1917. Make a graph which represents this condition.

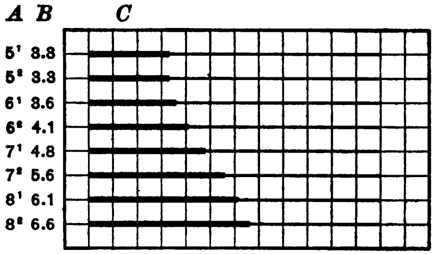
January....	$8.20	May......	$14.75	September .	$9.85
February...	8.10	June.....	13.00	October...	10.00
March.....	8.20	July......	10.50	November.	10.00
April......	9.75	August....	11.75	December .	10.30

8. Sugar was sold per lb. at these prices: 1914, 5¢; 1915, 6¢; 1916, $6\frac{1}{2}$¢; 1917, 7¢; 1918, 9¢; 1919, 12¢; 1920, 22¢. Show with a graph these changes in price from year to year.

9. Make a graph showing the prices for Thanksgiving turkey, which sold per lb. as follows: 1916, 30¢; 1917, 32.5¢; 1918, 35¢; 1919, 44¢; 1920, 56¢.

10. Construct the graph showing the attendance record of your own class for two weeks.

1. This series of graphs shows the result of a fraction test of 12 examples, similar to the one below, given to a large number of children distributed over eight different half school years. Study these graphs to see how they are made.



SCALE $= \frac{1}{8}$ IN. $= 1$ RIGHT

A = grade and half year.
B = achievement (average number right).
C = achievement in graphic form (heavy line).

2. Construct the graphs on the scale used in the figure if the achievement for the successive half years shown had been as follows: 3.5, 4.0, 4.2, 4.5, 5.0, 5.5, 6.2, 7.0.

3. See how many of these you can do right in 3 min.

1. $\frac{3}{4}+\frac{1}{6}=$	2. $\frac{5}{8}-\frac{5}{12}=$	3. $\frac{2}{3}\times\frac{3}{4}=$
4. $\frac{3}{4}\div\frac{1}{8}=$	5. $\frac{5}{6}+\frac{3}{8}=$	6. $\frac{7}{8}-\frac{3}{4}=$
7. $\frac{5}{8}\times\frac{16}{24}=$	8. $\frac{2}{3}\div\frac{5}{12}=$	9. $\frac{11}{12}+\frac{2}{3}=$
10. $\frac{5}{8}-\frac{3}{16}=$	11. $\frac{3}{4}\times\frac{20}{32}=$	12. $\frac{3}{8}\div\frac{3}{16}=$

4. Using the scale in the figure make a bar graph which shows your achievement in the test in No. 3.

5. Find the median achievement of the class (the median is the middle one in a series arranged in a descending or an ascending order). Make a bar graph for this median.

6. Make the graph for a girl who had 12 right.

7. What is the median in the following score: 3 had 4 right, 4 had 5 right, 1 had 6 right, 2 had 7 right, 5 had 8 right? Construct the graph for the median.

8. Make a graph showing the production of the four leading flaxseed states when the annual yield was as follows: North Dakota, 8,200,000 bu.; South Dakota, 3,500,000 bu.; Minnesota, 3,300,000 bu.; Montana, 3,100,000 bu.

HINT.—Let one unit of length in your graph represent 100,000 bushels.

9. If the total yield of flaxseed in the United States in one year was 19,500,000 bushels, compute the % produced by each state in problem 8. Using your answer, construct bar graphs for these four states and compare with the graphs in No. 8.

10. The average prices per lb. for unwashed wool for eight years were as follows: 1910, 17.7¢; 1911, 15.6¢; 1912, 18.7¢; 1913, 15.8¢; 1914, 18.6¢; 1915, 23.3¢; 1916, 28.4¢; 1917, 54.2¢. Find the average price for the eight-year period. Construct bar graphs showing the prices for the above period and the average price for the period.

11. In representing lengths to scale use is made of bar graphs. Show the relative lengths of the inch, foot, yard, and rod by a series of bar graphs, using first the scale 1 in. $=\frac{1}{16}$ in.; then the scale 1 in. = 1 mm.* (millimeter).

12. Compare graphically the meter with the yard.

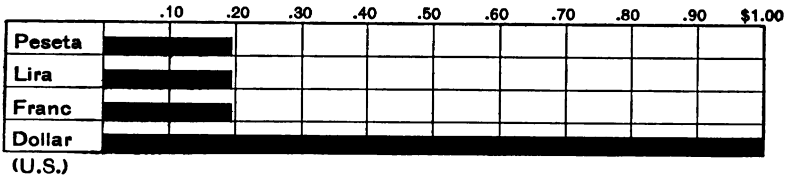
* NOTE.—In drawing bar graphs you will find it often more convenient to use metric units of length than English units. It is suggested that pupils have access to squared paper of both systems and that they be provided with rulers showing both metric and English units.

Table of Foreign Monetary Units

Name of Coin	Country	Normal Value in U. S. Money
Krona or Krone	Sweden, Norway, Denmark	$0.268
Florin	Netherlands	.402
Franc	France, Switzerland, Belgium	.193
Lira	Italy	.193
Mark	Germany	.238
Milreis	Brazil	.546
Peseta	Spain	.193
Peso	Mexico	.498
Peso	Philippine Islands	.500
Pound (Sovereign)	Great Britain	4.8665
Ruble	Russia	.515
Yen	Japan	.498

The above table gives the values of the standard monetary units of the countries most important with regard to their commercial relations with our country.

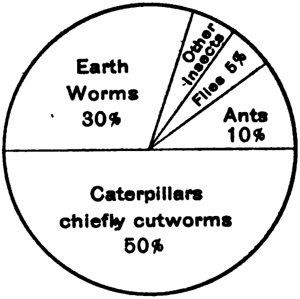
Below is a series of four bar graphs showing the value of three of these coins compared with the United States dollar. On a separate sheet copy these graphs and complete the series. Obtain the value of each coin from the above table.



1. Assuming the pound to be worth $4.8665, what is the value of a draft calling for 98.5 pounds in United States money?

2. At one time during the World War the pound was quoted at $4.73. How many % below par (the normal value) was that? What is the present value of the pound?

Learning and Using Circle Graphs



1. The circle graph at the left shows the relative amount of different foods eaten by baby robins.

Caterpillars are 50% of the food, or 180° of the 360° of the circle.

Earthworms are 30%. .30 of 360° = 108°. (Lay off with the protractor or estimate as accurately as you can.)

Ants are 10%. .10 of 360° = 36°.

Flies are 5%. .05 of 360° = 18°.

The remainder is other insects. Find it in %. How is it shown in the circle graph?

2. Make a circle graph to show the relative amounts of the bluebird's food. It is 75% insects and 25% wild fruit and other vegetable matter. Do you think the bluebird is a valuable bird to the farmer?

3. The diet of the cowbird consists of wasps and ants $12\frac{1}{2}$%, seeds $12\frac{1}{2}$%, spiders $12\frac{1}{2}$%, and grasshoppers and caterpillars the remainder. Draw a circle graph to show this condition.

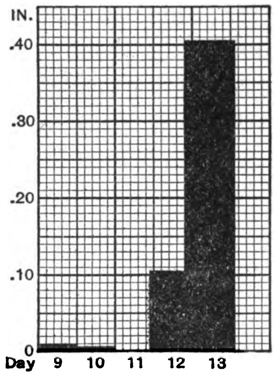
4. About 150,000,000 sq. mi. of the earth's surface are water and 50,000,000 sq. mi. are land. Make a circle graph to show this relation.

5. The United States produced in 1915 about $\frac{1}{4}$ of the world's wheat crop. Draw a circle graph showing the relation of the wheat crop of the United States to that of the rest of the world.

6. The United States produces $\frac{3}{4}$ of the world's corn crop, which for a recent year was 3,624,000,000 bushels. Draw a circle graph. Place in the proper spaces (sectors) the crop of the United States and that of the rest of the world.

7. Minnesota, Michigan, and Alabama produce 60%, 22%, and 9% of the yearly output of iron ore in the United States. Draw a graph showing the production of these states and the rest of the United States. If the yearly production is 56,000,000 tons, what does each sector of your graph represent in tons?

Rectangle Graphs



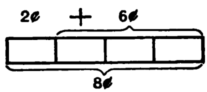
In this graph is shown the rainfall in St. Louis for five consecutive days in August, 1918. Read the graph.

The rainfall in hundredths of an inch is shown on the vertical line. 1 mm. = .01 in. The days are recorded on the horizontal line.

1. Make a graph showing rainfall as follows: May 3.28 in., June 1.47 in., July .60 in., August 5.26 in., September 5.09 in.

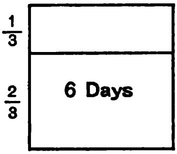
2. Make a graph showing the heights of two boys if one is 60 in. and the other is 64 in. tall.

3. James and John together have 8¢. James has 3 times as much as John. How much money has each?



Let a small rectangle stand for John's money. Then 3 such rectangles stand for James's money. Read each boy's part.

4. How long will it take to complete a piece of work after $\frac{2}{3}$ of it was done in 6 days?



A graph of this character is all the solution that is necessary in many problems of this type.

Show your solution for each of the following problems with a rectangle graph.

5. Ray and Robert together have 30 marbles. Ray has 4 times as many as Robert. How many has each?

6. Jane has twice as many apples as Mary, and both have 15. How many has each?

7. Alice solved $\frac{2}{3}$ as many problems as Ada. Both solved 20. How many did each solve?

8. Two rectangles together have 192 sq. ft. If one is 2 times as large as the other, find the area of each.

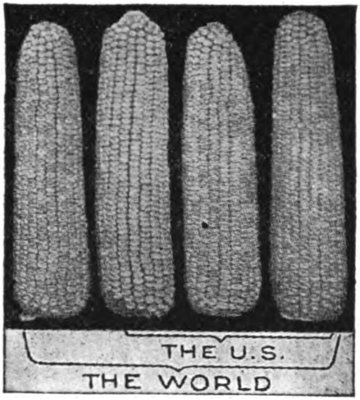
9. Frank caught three fish whose total weight was 96 oz. The weight of the second was twice that of the first, and that of the third was three times that of the first. Find the weight of each.

10. In 1915 the average corn crop in the United States was $37\frac{1}{2}$ bu. per acre. An Ohio farmer raised 100 bu. per acre. W. H. Dunson, a record corn grower, raised 232 bu. on one acre. Draw rectangle graphs showing the above results.

Hint.—Let 1 unit in height of graph represent $37\frac{1}{2}$ bu.

11. The average monthly prices per lb. of butter in Illinois from Jan. 1917 to Dec. 1917 were as follows: 34¢, 32¢, 33¢, 32¢, 35¢, 34¢, 33¢, 34¢, 35¢, 38¢, 40¢, 40¢. Find the average for the year. Construct graphs showing the monthly and the average price for the year.

Pictorial graphs use pictures of the objects to be compared. In the figure the 4 ears represent the world's corn crop in 1916; 3 of them represent the crop of the United States in the same year.



1. The corn crop of the United States in 1916 was 2,718,000,000 bushels. What was the world's crop?

2. How many bushels are represented by each ear in the figure?

3. The United States raised $\frac{5}{8}$ of the world's cotton in a recent 5-year period. Show this with a pictorial graph.

4. The world's average yearly cotton crop for a five-year period was 23,000,000 bales. How many bales does each unit in your graph represent?

5. What was the average yearly cotton production of the United States in bales?

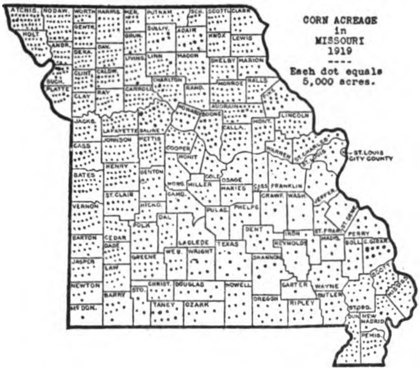
6. A bale of cotton weighs 500 lb. At 30¢ a lb. (1918 price) find the value of the world's cotton crop.

7. Frank has 10 times as much money as Roy. Draw a pictorial graph showing their comparative wealth.

8. One apple tree bore 10 bushels of fruit; another one in the same year had 20 bushels. How would you represent the yield of these two trees with a pictorial graph?

9. The United States produces one-fifth of the world's wheat crop. Draw a pictorial graph to show this relation.

Learning the Distribution Graph



This form of graph is much used in the United States Government reports. It is also often found in geography texts. The graph in the figure shows the distribution by counties of the corn acreage in Missouri in 1919. Each dot in this graph equals 5000 acres.

The first step in the making of such a graph is to give a value to each dot. Then find out the number of dots belonging to each geographical unit and place them properly.

1. The following table shows the population of each of the six New England states for 1920. Draw an outline map of these states. Place properly in each state one dot for each 50,000 population. You now have a distribution graph.

Maine	767,996	Massachusetts	3,851,615
New Hampshire	443,083	Connecticut	1,380,585
Vermont	352,421	Rhode Island	604,397

2. Make a distribution graph of the pupils in your schoolroom when all are in their seats. What is the difference between a map of this room and the graph you have made?

3. Consult your text in geography for good examples of this kind of graph.

CHAPTER II

THE TABLE SOLUTION IN PROBLEM SOLVING

By this method you can find rapidly several values from a large number of facts. In the table in problem No. 1 7 different values are required from the same set of facts.

1. The following table shows the number of times three baby robins were fed for four consecutive days.

Age	By Female	By Male	Total
6 days	22	44	?
7 days	39	46	?
8 days	54	31	?
9 days	64	30	?
Total	?	?	?

Find the value of each question mark. What does each represent? Prove the last total.

2. The following is a weekly statement in hours such as is usually kept by employers of labor.

Name	M	T	W	T	F	S	Total Hr.	Wages per Hr.	Amt. Due
Smith	7	9	10	$6\frac{1}{2}$	8	5	?	50¢	?
Boyd	$8\frac{1}{2}$	10	10	$9\frac{1}{2}$	8	3	?	45¢	?
Jones	9	10	9	$6\frac{1}{2}$	10	4	?	60¢	?
Total	?	?	?	?	?	?	?		?

(1) Find the total number of hours each man worked.

(2) Find each man's pay for the week.

(3) Find the total number of hours worked daily.

(4) The sum of the daily totals should be equal to the sum of the laborers' totals. Is it?

3. This table contains the number and total value of the hogs in each of the six leading hog states in the United States in 1918.

State	Number	Value	Av. Value
Iowa	10,307,000	$249,429,000	?
Illinois	5,111,000	112,442,000	?
Missouri	4,708,000	87,098,000	?
Nebraska	4,200,000	102,480,000	?
Indiana	4,168,000	84,194,000	?
Ohio	3,774,000	77,367,000	?
Total	?	?	?

(1) Find the value of each question mark.

(2) Arrange the states in the order of highest average value.

4. The total number of hogs in the United States in 1918 was 71,374,000, having a total value of $1,392,276,000.

(1) What was the average value per head?

(2) How does this value compare with the average value for the six leading states in problem 3?

(3) What % of the total number of hogs in 1918 is found in the six leading states? What % of the total value?

5. In 1917 Walter Whitman, a boy living in Indiana, raised a pig weighing 456 lb. at 8 months of age.

(1) What was the average growth per day if the weight at birth was 3 lb.?

(2) This pig gained in 4 consecutive weeks as follows: 18 lb., 21 lb., 27 lb., 24 lb. Find the weekly and daily average gain for this period.

(3) Find the market value of this pig at the current price.

6. This table shows in bushels the principal cereal crops in 10 states in 1917.

State	Corn	Oats	Wheat	Total
Ohio	150,100,000	78,100,000	41,140,000	?
Indiana	203,436,000	76,440,000	33,392,000	?
Illinois	418,000,000	244,400,000	30,400,000	?
Iowa	410,700,000	246,750,000	8,350,000	?
Missouri	252,000,000	59,200,000	27,540,000	?
Kansas	128,124,000	70,804,000	45,934,000	?
Nebraska	249,480,000	115,444,000	13,764,000	?
Wisconsin	42,196,000	99,000,000	5,327,000	?
Minnesota	90,000,000	120,250,000	57,965,000	?
Washington	1,517,000	11,242,000	29,218,000	?
Total	?	?	?	?

(1) Find the value of each question mark.

(2) Arrange the states in the order of production (a) of corn, (b) of oats, (c) of wheat, (d) of total.

(3) Compare the order of the 6 leading corn states with that of the 6 leading hog states in problem 3 on page 14.

(4) The total wheat crop in the United States in 1917 was 650,828,000 bu. How much was grown by the states not named? What % was grown by the states named?

(5) Name 3 important wheat states not found in the table.

(6) The total corn crop in the United States in 1917 was 3,159,494,000 bu. What % was grown by the states not named in the table?

(7) Make bar graphs showing the corn crop of Minn., O., and Ia. in 1917; also bar graphs showing the wheat crop of Ill., Kan., and Minn. in 1917.

Finding the Balance by Addition

1. 3+4+7+?=20.

This example may be solved in two ways. (1) Find the sum of 3, 4, and 7; then subtract it from 20. (2) Think what must be added to the sum of the known addends to make 20. Say, "14 and 6 are 20."

2. 246+382+563+?=1480.

First Method

246	1480
382	1191
563	289
1191	

By the first method find the sum of the 3 given addends. Then subtract this sum from 1480.

Second Method

1480	Sum
246	Known Addends
382	
563	
?	Balance
1480	Proof

By this method add the units' column, saying 5, 11, and 9 make 20. Write the 9 in the units' column. Carry the 2 and add the tens' column by saying 8, 16, 20, and 8 make 28. Write 8 in tens' column. Carry 2 and add the hundreds' column, saying 7, 12, and 2 make 14. Write 2 in hundreds' column. The balance to be supplied is 289. For proof add the three addends and the balance. The sum must be 1480.

Principle.—The sum of all the parts (addends) must equal the whole.

Supply the balance in these examples and problems.

	1.	2.	3.	4.	5.
Sum	30	362	1674	$20.00	$100.00
Addends	8	24	185	1.49	16.48
	4	85	263	5.63	32.52
	3	63	459	3.28	35.89
Balance	?	?	?	?	?

6. John Boyd had $250. How much will he have left (balance) after paying bills of $21.15, $75.84, $15.25?

7. A boy raised 240 lb. of tomatoes in his thrift garden. He sold 105 lb. to a neighbor, gave 15 lb. to his uncle, ate 10 lb. during July and August, and gave the balance to his mother. How many pounds did the mother receive?

8. Brownlee's ten-cent store has ten cash registers. Saturday morning the following amounts were put in these registers for making change: in No. 1, $12.85; No. 2, $43.75; No. 3, $25.54; No. 4, $17.38; No. 5, $31.62; No. 6, $18.47; No. 7, $31.79; No. 8, $19.56; No. 9, $23.80; No. 10, $52.76. During the day the receipts registered by them in the order stated were as follows: $114.92; $187.45; $49.38; $61.54; $102.09; $136.58; $79.40; $126.82; $96.39; $157.69. Payments were made from these registers during the day as follows: from No. 1, $27.56; No. 2, $96.45; No. 3, $10.87; No. 4, $14.32; No. 5, $57.86; No. 6, $90.80; No. 7, $23.59; No. 8, $61.38; No. 9, $17.74; No. 10, $64.27. Prepare a statement showing in table form all of the facts given above. You will need at least five columns. Some pupils use six. Place in the right hand column the balances in the different registers. Place at the bottom the total on hand at the beginning of the day, total receipts, total payments, and total balances at the end of the day.

The Cash Account

In making a Cash Account write on the debit side (left) all the cash received and on the credit side (right) all the cash spent. The bookkeeper's rule is,

"Debit all that comes in, credit all that goes out."

Cash

1918						1918				
Mar.	1	Bal. on hand	523	69	Mar.	1	Rent	35	—
	3	H. J. Harkness	125	60		2	Expense	5	25
	11	M. W. Wilms	26	52		7	Postage	12	64
	15	Mdse. Sales	354	27		15	Salaries	42	50
	22	J. C. Rankin	195	43		24	Advertising	25	75
	31	Mdse. Sales	586	29		31	Salaries	42	50
						31	Expense	2	27
						31	Balance (Red)	*****	**
			*****	**				*****	**
Apr.	1	Balance	*****	**					

1. On whose book is this Cash Account found?

2. Did J. C. Rankin on Mar. 22 receive or pay $195.43? How do you know?

3. Who paid rent on Mar. 1?

4. Who paid salaries on Mar. 31? Who received them?

5. The footings indicated by ******** are usually written in pencil.

6. The Balance on Mar. 31 is the amount which must be added to the smaller side to make it equal to the larger side. Find it. This is often written in red ink.

Methods of Finding the Balance

I. From the sum of the larger side subtract the sum of the smaller side. Write this difference, called the Balance, on the smaller side.

II. Find the larger side by inspection. Add it. Then find what must be added to the smaller side to make it equal to the larger side by the method shown on page 16.

HINT.—As a check on your work add the smaller side and the balance once more to see if this sum equals the larger side.

Problems

1. Make the account and find the balance in (1) and (2).

(1) On Monday morning a grocer began business with $15.80 on hand. The week's receipts by days were $24.15, $35.40, $32.45, $22.40, $30.20, $50.65. During the week he paid out $20.10, $14.25, $10.85, $17.35, $30.25, $28.60.

(2) Let this be your account for January.

Receipts: Jan. 2, cash on account, $1.15; Jan. 5, shoveling snow, 75¢; Jan. 10, caring for the neighbor's furnace, 60¢; Jan. 25, working at the grocer's on 3 Saturdays, $3.00.

Expenses: Jan. 8, movies, 10¢; Jan. 14, book, 50¢; Jan. 16, pair of skates, $1.00; Jan. 28, candy 20¢.

2. Balance each of these accounts.

1.		2.		3.	
Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
$ 35.60	$ 63.95	$152.60	$254.80	$92.50	$102.60
182.50	150.24	328.90	796.20	32.20	32.50
96.78	56.38	426.48	805.60	5.80	16.85
526.35	407.62		20.40	16.25	

CHAPTER III

THE EQUATION IN PROBLEM SOLVING

Explaining and Using Equations

$23 + ? = 37.$

This is an example in addition because one addend is wanted. The result is 14 because 23 added to 14 equals 37.

In each of these examples tell first which fundamental process is shown by the equation; then tell the result.

	a	b	c
1.	$3 + ? = 7$	$? + 5 = 8$	$2\frac{1}{2} + 3\frac{3}{4} = ?$
2.	$15 - ? = 8$	$2\frac{1}{2} - \frac{5}{8} = ?$	$? - 6 = 10$
3.	1 lb. $-$ 12 oz. $= ?$	$3\frac{3}{4} - ? = 2$	$4\frac{1}{5} \times ? = 21$
4.	$? \times 6 = 72$	$2\frac{1}{2} \times 6 = ?$	$? \times \frac{1}{2} = 24$
5.	$8 \div ? = 2$	$? \div 6 = \$4$	$12 \div \frac{2}{3} = ?$
6.	$\frac{96}{12} = ?$	$\frac{48}{?} = 3$	$\frac{?}{6} = 7$
7.	$17 + 16 + ? = 40$	$\frac{32}{?} + 8 = 10$	$15 + ? + 14 = 31$
8.	$11 + 10 - ? = 9$	$6 \times 8 + ? = 57$	$5 \times ? + 4 = 24$

The Use of Arithmetical Signs

1. If we wish to write the statement of a problem in an equation, we need to know the use of the arithmetical signs.

2. The next three paragraphs express the usage commonly followed by mathematicians.

(1) In an expression having + and − only, perform the operations in the order indicated.

$$8 - 6 + 3 - 2 = 2 + 3 - 2 = 5 - 2 = 3.$$

(2) When either $\times$ or $\div$ or both are used in connection with $+$ or $-$, parentheses ( ) may be used to help show the meaning.

$(8 \times 4) + 6$ means a product is to be added to 6.
$8 + (48 \div 3)$ means add 8 to a quotient.
$(6 \times 7) - (12 \div 3)$ means subtract a quotient from a product.
$(7 + 4) - (24 \div 8)$ means subtract a quotient from a sum.

(3) If $\times$ and $\div$ succeed each other in an expression, the work should be done in the order of the occurrence of these signs.

$$6 \div 3 \times 4 = 8, \text{ not } \tfrac{1}{2}. \quad 15 \times 4 \div 3 = 20.$$

3. Every equation in arithmetic should be explained as an example either in addition, or in subtraction, or in multiplication, or in division.

(1) $(3 \times 4) + (6 \times 2) = ?$
An example in addition: the sum of two products.
(2) $(3 \times 4) - (8 \div 4) = ?$
Subtraction: a product minus a quotient.
(3) $6 \times 8 \div 3 = ?$
Division: the dividend a product.
(4) $24 \div 6 \times 5 = ?$
Multiplication: one factor a quotient.

Examples

Explain first as suggested above; then solve using pencil only where necessary.

	a	b
1.	$(8 \times 4) + (3 \times 5) = ?$	$36 - (18 \div 6) = ?$
2.	$5 + (8 \times 5) = ?$	$(3 \times 4) + (8 \times 5) - (12 \div 6) = ?$
3.	$(6 \div 2) + (3 \times 10) = ?$	$(5 \times 6) - (2 \div 4) + (7 \times 2) = ?$

	a	b
4.	$(15 \div 5) + (21 \div 7) = ?$	$(6 \times \frac{1}{2}) + (8 \div 4 \times 7) = ?$
5.	$(24 \div 6) - (34 \div 17) = ?$	$7 \times 8 \div 4 - (6 \times 2) - (8 \div 8) = ?$
6.	$25 \times 2 \div 10 = ?$	$(3 \times 5^2) + 7 = ?$
7.	$18 \div 6 \times 5 = ?$	$(18 \div 6) + (7 \times 4) - 24 + (8 \times 4) = ?$
8.	$27 \div 3 \times 4 - 5 = ?$	$(8+4) \times (16-12) = ?$
9.	$25 - 10 + 5 = ?$	$(7-3) \times (8+2) - (6 \div 2) = ?$
10.	$18 + (4 \div 2) = ?$	$(14 \div 2) + (4-3) + (6 \times 8) = ?$

Solving Problems with the Equation

The equation is the sentence of mathematics. It is the most effective working tool of those who wish to think and express themselves **accurately** in number relations. On this account the equation method of solving problems is the most desirable one in many cases.

Steps in Solving a Problem

1. Find out what the problem says.

2. Find what is wanted.

3. Find the necessary data (things known).

4. Find the relation between what is wanted and what is given. This relation can be expressed in terms of one of the four fundamental processes.

5. Express the relation found in the 4th step as an equation, either in oral or written form. (The reasoning is completed at this point. The rest of the work is computing.)

6. Estimate the result.

7. Simplify the equation.

8. Test your result for reasonableness.

9. Prove your answer.

1. A dairy farmer traded at the grocery store butter worth 50¢ a lb. for 3 lb. tea @ 75¢, 10 lb. coffee @ 30¢, and 20 lb. sugar @ 10¢. How many pounds of butter did he have?

Thinking.—Number of lb. of butter = value of the butter ÷ value of 1 lb.

Statement.—

$$\text{Number of lb. of butter} = \frac{3 \times 75¢ + 10 \times 30¢ + 20 \times 10¢}{50¢}$$

Computation.—Number of lb. of butter $= \dfrac{\$2.25 + \$3 + \$2}{50¢}$

$$\text{Number of lb. of butter} = \frac{\$7.25}{50¢} = 14\tfrac{1}{2}$$

2. A man works on a salary of \$25 a week for 50 weeks in a year. He uses 80% of his income for living expenses and 50% of the balance for thrift stamps at 25¢ each. How many thrift stamps does he buy?

Thinking.—The no. of thrift stamps bought = no. bought in 1 week × no. wk.

Statement.—No. of thrift stamps bought $= \dfrac{\frac{1}{2} \times \frac{1}{5} \times \$25}{25¢} \times 50.$

Computation.—No. of thrift stamps bought = \$2.50 ÷ 25¢ × 50.

No. of thrift stamps bought = 500.

3. A man bought 100 acres of land at \$80 an acre and 25 acres at \$90 an acre. He sold it all at \$85 an acre. Did he gain or lose? How much?

Thinking.— Gain = selling price − cost.

Statement.— Gain = (125 × \$85) − (100 × \$80 + 25 × \$90).

Computation.—Gain = \$10625 − (\$8000 + \$2250).

Gain = \$10625 − \$10250.

Gain = \$375.

$$\begin{array}{r} 125 \\ \times 85 \\ \hline 1000 \\ 625 \\ \hline 10625 \end{array}$$

Note.—It is a good plan to place all the necessary computations on the paper having the statement.

4. A wholesale grocer bought 12 bbl. of Jonathan apples @ $3, 10 bbl. Grimes Golden @ $3.25, and 8 bbl. of Ben Davis @ $2.75. He sold them at an average of $3.50 per bbl. Find his profit.

5. The overcoats furnished our soldiers in France cost our government $14.92 each. A village bought in one day 357 War Savings Stamps at $4.18 each. How many overcoats could be bought with this money and how many cents would remain?

6. A dealer bought 50 bbl. of flour @ $9.50. He sold 60% of it @ $10.20, and the remainder @ $11.00. Find his profit.

7. A retail grocer bought a box containing 64 Florida grapefruit for $2.75 and retailed them at 5¢ each. Find his % of gain if 4 were decayed.

8. If a grocer can buy Jello in packages at $11.52 per 144, how much must he charge for it a package to make 25% profit?

9. Soap costing $2.40 a dozen is sold at 25¢ a cake. Find the rate of gain.

10. How far does an express train run in 1 hr. 36 min. at 50 miles an hour?

11. A certain class during an experiment used 10 cu. ft. of gas. Find its cost at 90¢ per 1000 cu. ft.

12. During the recent World War United States vessels carried without loss of a single life 961,537 of our men out of a total of 2,079,000. British vessels carried 1,008,315; French and Italian the remainder. What % of the total was carried by each of these three groups?

13. An auto truck draws a load of bricks weighing 3 tons. The bricks are of the ordinary size, 8″ by 4″ by 2″, and weigh 100 lb. to the cu. ft. How many bricks in the load?

14. On Sept. 17, 1918, 63 hogs averaging 228 lb. were sold at the National Stock Yards at East St. Louis at $20.75 per 100 lb. Find the value of the lot.

15. On January 1, 1919, eggs sold at 75¢ a dozen. One month later the same grade of eggs sold at 53¢. Find the % of reduction.

16. Sugar sold in Chicago in 1918 at 10¢ a lb. In May, 1920, it sold at 28¢. Find the % of increase.

17. On January 1, 1919, butter in a certain city retailed at 73¢ a lb. One month later the price for the same grade was 47¢. Find the % of drop.

18. A Goodyear motor truck in 1918 carried a full load from Boston to San Francisco and returned via Los Angeles to Boston with a full load making the 7763-mile round trip in 24 da. 1 hr. 55 min. What was the average rate of travel per hour?

19. 71.5% of the journey described in problem 18 was made over unimproved roads. How many miles of improved road were there in this journey?

20. On December 14, 1918, Lieutenant Jones left Houston, Texas, in an airplane at 9:12 A.M., arriving at Waco at 11:50 A.M., distance 197 mi. This plane flew against a 45-mile per hour wind all the way. What was the actual speed developed by the engine of the plane?

CHAPTER IV

REVIEWING THE METHODS OF PROBLEM SOLVING

In the previous chapters you have learned three methods of stating the solution of problems; namely, by graph, by table, and by equation. Using the following statements as a guide, select the method which is most suitable to the problem, then solve it.

(1) If you wish to show number relations in a striking manner with only approximate accuracy, use the **graph solution.**

(2) If you wish to get quickly several values from a large amount of data, use the **table solution.**

(3) If you need to show and find accurate number relations use the **equation solution.**

1. St. Louis produced in 1916 1,750,636 bbl. of flour; in 1917 1,619,256 bbl.; in 1918 1,398,283 bbl. Show in some obvious manner the relative production of each year. How many pounds were produced in the three years? (A bbl. of flour = 196 lb.)

2. In problem 1 compare the 1918 production with each of the other years, carrying the results to the nearest tenth of a per cent.

3. Find the value of the flour in problem 1 at 6¢ a lb.

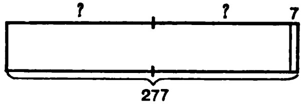
4. If each loaf of bread required $\frac{3}{4}$ lb. of flour, how many loaves of bread could be made from the flour in problem 1?

5. A given oblong is twice as long as it is wide. Its perimeter is 48 inches. Find the length and width.

HINT.—How many equal parts in 48? See diagram.

6. The sum of three numbers is 72. The second number is three times the first, and the third is four times the first. What are the numbers? HINT.—Draw a rectangle graph.

7. In one school there are 7 more pupils than in a second school. In both there are 277 pupils. How many are there in each?



8. A lady paid twice as much for a hat and half as much for a pair of gloves as she paid for a pair of shoes. For all she paid $21. What did she pay for each?

HINT.—Show your thinking with a rectangle graph.

9. A farm yielded twice as many bushels of oats as wheat and four times as many bushels of corn as oats. The total yield was 1683 bu. What was the yield of each crop?

10. The goal in a certain fraction race was 100 examples in 30 minutes. One pupil had 95 right, another had 84 right, a third one had only 48 right. Show the achievement of these pupils in the most striking manner.

11. A ten dollar bill is offered in payment of each of the following debts: $2.47, $5.62, $7.89, $1.19, $.78, $3.85, $5.52, $6.98, $9.43, $8.96. How much change should be returned in each case?

12. The receipts of one department of a large store for one week were as follows: Mon. $480.25; Tues. $520.60; Wed. $456.35; Thurs. $382.75; Fri. $410.22; Sat. $580.60. What were the average daily receipts?

13. The rainfall in a certain large city for four consecutive months was as follows: 3.15 in., 2.84 in., .75 in., 4.18 in. Show this condition by proper graphs.

14. The distance between Chicago and St. Louis via the Chicago and Eastern Illinois is 290.4 miles. The train which leaves Chicago at 10 A.M. is scheduled to arrive at St. Louis at 5:50 P.M. What is the average rate of travel of the train when it is on time?

15. The distance between New York City and Chicago over one railroad is 954 miles; over another road it is 918 miles. What is the difference in the average speed of the two trains which make the journey in exactly 18 hours?

16. A war savings stamp in Sept., 1920, cost $4.20. What per cent of a $50 Liberty Loan bond is this?

17. Find the sum of money loaned for 3 months at 6% required to earn $15 interest.

18. If twice the width of the lace used must be allowed for turning a square corner, how much lace will be needed to finish a handkerchief 10 in. square with $\frac{5}{8}$-inch lace?

19. A dresser cover 18 inches by 45 inches is to be finished with $1\frac{3}{4}$ inch lace on the two ends and front. A pin cushion 4 in. x 15 in. is also finished with the lace. How many yards of lace will be required for both?

20. A farmer sold $137\frac{1}{2}$ bushels of Baldwin apples at $4.25 per barrel. Each barrel contained 2 bu. 3 pk. How much did he receive?

21. The quota of each Federal Reserve district and its subscription as announced Feb. 21, 1919, to the Fourth Liberty Loan are shown below. Find the total quota, the total subscription, and each district's oversubscription.

District	Quota	Subscription	Oversubscription
Boston	$ 500,000,000	$ 632,124,000	?
New York	1,800,000,000	2,044,931,000	?
Philadelphia	500,000,000	598,763,000	?
Cleveland	600,000,000	701,909,000	?
Richmond	280,000,000	352,685,000	?
Atlanta	192,000,000	217,885,000	?
Chicago	870,000,000	969,209,000	?
St. Louis	260,000,000	295,340,000	?
Minneapolis	210,000,000	242,046,000	?
Kansas City	260,000,000	295,951,000	?
Dallas	126,000,000	146,090,000	?
San Francisco	402,000,000	462,250,000	?
Total	?	?	?

(1) Find the total oversubscription in two ways.

(2) What % is the total oversubscription of the total quota?

(3) What % is the oversubscription of your district of its quota? How does this compare with the answer in (2)?

(4) Compare the % of oversubscription of Boston with that of New York.

(5) Make a similar comparison of Dallas with Atlanta; of Kansas City with St. Louis.

(6) Compare in a similar manner your own district with a neighboring one.

22. The freight rate on 500 bu. wheat shipped from Minneapolis to Chicago was 10¢ a hundred lb.; drayage was $18. What was the transportation cost per bushel?

23. The population of Pittsburgh in 1910 was 533,595. In 1920 it was 588,193. Find the rate of increase.

24. The Union Gas Co. has 6 cashiers. The collections by each cashier daily for one week are given in the order of the days of the week: Miss Jones, $418.20, $392.16, $408.95, $375.62, $296.90, $425.16; Miss Will, $428.40, $250.20, $317.75, $296.18, $324.82, $386.24; Miss Arnold, $432.15, $252.65, $400.20, $385.62, $216.94, $465.70; Miss Casey, $296.33, $384.24, $253.16, $484.20, $416.10, $258.95; Miss Baker, $304.15, $215.93, $392.99, $456.32, $389.05, $304.01; Miss Sands, $286.66, $310.04, $464.82, $562.80, $362.19, $218.92.

(1) Find the company's daily and weekly collection and the total of each cashier.

(2) Find each cashier's pay for the week if she receives 1% of her collections.

(3) Find the difference between the best and the poorest day's collections.

25. A certain sign board for city advertising is 50 feet long and 8 ft. high. If a margin 12 inches wide is allowed, how many square yards of advertising space on the board?

26. The highest priced car load of cattle ever sold at the National Stock Yards, Chicago, consisting of 20 steers averaging 1068 lb., were sold on Dec. 16, 1918, at $19.50 per hundred pounds. Find the value of the cattle.

A traveling salesman sent to his firm this expense account for October.

Find the total expense for each day, the total expense of each kind, and the total of all expense for the month.

Wilson & Gibbons—Travelers' Monthly Expense Sheet

Salesman ______________________ Month of ____________ 19___

Date	Carfare		Hotel		Baggage		Incidentals		Total	
1	$2	78	$2		$1	20	$2	15		
2	1	70	2	50		90	3	10		
3	1	10	3			75	2	80		
5	2	54	3		1	40	3	40		
6	3	25	2	50	1	80	1	75		
7		90	2			15		50		
8	2		2	50		80		75		
9	2		2			70		60		
10		40	2	50		10		25		
12	1	35	3			45	1			
13	1	12	2	50		65		90		
14	1	60	2	50		45	1	25		
15		85	2			60		40		
16	1	10	2			75		25		
17	3		2		1	20	1	10		
19	1	80	2			40		30		
20		65	2	50		20		80		
21	1	25	2	50	1	10		45		
22		30	2			20		20		
23		96	2			40		60		
24		50	2	50		20		10		
26		42	2	50		20		18		
27		70	2			25	1			
28	3	12	3		1	40		20		
29	2	40	2	50	1	80	2	35		
30	1	76	2			85		47		
31	2	20	2	50	1		1	15		

NOTE.—After adding, prove by adding to the sum of the first 14 items the sum of the rest of the items in that column.

CHAPTER V

PRACTICE TESTS FOR ACCURACY AND SPEED

Each of these exercises is designed to require 3 minutes in which to write the answers unless otherwise indicated.

I

3	8	5	7	3	7	8	3	4	6	5	3
8	3	0	8	2	9	2	9	2	4	8	2
4	7	1	5	9	4	5	6	8	3	3	9

4	3	2	9	3	7	6	9	7	4	8	4
2	5	6	9	0	7	8	5	6	7	7	5
8	5	6	2	9	6	8	4	5	7	5	6

5	6	9	8	7	6	5	3	6	5	4	3
3	7	9	8	6	3	2	8	2	9	2	8
2	8	9	4	7	6	1	7	4	8	7	9

II

2	3	4	4	5	3	7	3	4	7	4	3
4	9	8	8	2	6	8	5	9	4	2	0
6	5	0	8	7	9	4	8	5	2	6	9
7	4	2	4	8	5	5	9	8	3	8	8

4	9	2	8	1	3	7	3	5	3	5	2
8	1	5	9	9	4	8	2	2	9	6	4
7	8	6	2	2	2	9	8	6	8	8	9
3	7	7	5	8	8	6	8	4	4	4	6

III

a	b	c	d	e	f	g	h	i	j	k	l
2	3	9	5	7	3	9	5	9	3	8	9
4	5	2	1	7	6	9	4	6	6	8	6
6	9	7	4	3	7	3	7	2	3	6	3
3	1	8	5	8	2	2	8	1	5	3	2
1	7	5	2	2	9	4	9	7	8	1	5
5	2	3	8	9	8	7	7	4	8	9	7
5	1	4	3	4	4	8	3	5	9	9	8
8	9	3	7	5	1	2	4	1	7	2	2
2	9	6	9	6	5	4	3	8	4	7	5
7	2	7	1	4	3	6	2	9	2	2	4

IV

What must you add to each of the following to make 100?

1.	40	25	37	84	52	33	19	82	76	53	96	26	59	89	36
2.	18	32	56	92	37	46	83	25	88	14	41	77	22	35	69
3.	85	92	28	15	63	39	23	29	79	58	26	86	44	74	12

The following are the 45 subtraction facts whose minuends exceed 9. Write the answers in one minute.

1.	18	10	16	12	17	15	12	15	13	14	16	10	11	10	10
	9	9	9	9	8	8	7	6	5	8	7	7	6	4	1
2.	17	14	12	13	14	10	12	11	12	18	16	11	14	10	13
	9	9	8	7	6	6	5	4	3	9	8	7	5	2	2
3.	13	10	14	13	10	10	15	12	11	11	12	11	15	13	11
	9	8	7	6	5	3	7	6	3	2	4	8	9	8	5

V

348	104	256	596	632	328	219
956	859	732	328	236	254	921
284	236	510	746	305	796	367
329	789	105	259	475	320	673
782	978	328	363	583	465	852
256	854	964	854	632	752	263

VI

.003	2.567	.015	2.70	16.254
.258	1.842	.094	.38	15.389
1.174	5.004	2.589	.04	14.562
2.389	.02	3.647	1.18	12.048
5.643	.9	5.289	2.92	1.056
7.809	.045	.012	8.46	.372

VII

$228.30	$965.20	$263.22	$326.74	$257.96
17.54	104.52	17.84	28.95	26.94
89.26	32.84	2.52	22.78	6.68
.37	1.58	.48	38.29	24.95
56.24	.25	26.37	1.51	17.24
135.86	2.46	89.26	22.94	89.75

VIII

	a	b	c	d
1.	$\frac{1}{2}+\frac{3}{4}=?$	$\frac{1}{2}+\frac{5}{6}=?$	$\frac{7}{12}+\frac{1}{2}=?$	$\frac{7}{8}+\frac{5}{24}=?$
2.	$\frac{2}{3}+\frac{5}{6}=?$	$\frac{5}{16}+\frac{5}{8}=?$	$\frac{3}{4}+\frac{11}{12}=?$	$\frac{11}{12}+\frac{11}{24}=?$
3.	$\frac{3}{4}+\frac{5}{8}=?$	$\frac{2}{3}+\frac{3}{4}=?$	$\frac{3}{4}+\frac{1}{8}=?$	$\frac{7}{8}+\frac{7}{16}=?$

IX

Business men and clerks make change by the adding method. Make change in this manner for the following.

	Amt. Given	Amt. of Purchase	Change		Amt. Given	Amt. of Purchase	Change
1.	$4.00	$3.57	?	11.	$10.00	$2.25	?
2.	1.00	.33	?	12.	5.00	1.23	?
3.	5.00	1.52	?	13.	2.00	.60	?
4.	.50	.15	?	14.	5.00	1.10	?
5.	5.00	.23	?	15.	.50	.37	?
6.	3.00	2.52	?	16.	.75	.61	?
7.	10.00	.96	?	17.	10.00	1.29	?
8.	1.00	.87	?	18.	20.00	13.20	?
9.	2.00	1.13	?	19.	20.00	15.46	?
10.	1.00	.57	?	20.	10.00	9.81	?

X

A good subtracter can do 10 right in 3 minutes. Can you beat this record?

	a	b	c	d	e
1.	329642	896284	300296	248654	756200
	158364	99396	125472	159728	297472
2.	500482	963475	604325	932846	923482
	329624	252289	150296	582496	152926

XI

	a	b	c
1.	$\frac{3}{4}-\frac{1}{2}=?$	$\frac{2}{3}-\frac{1}{2}=?$	$\frac{3}{4}-\frac{5}{8}=?$
2.	$\frac{7}{8}-\frac{3}{4}=?$	$\frac{3}{4}-\frac{7}{16}=?$	$\frac{1}{4}-\frac{1}{24}=?$
3.	$2\frac{1}{2}-\frac{1}{3}=?$	$3\frac{3}{4}-\frac{7}{8}=?$	$2\frac{1}{2}-2\frac{1}{3}=?$
4.	$7\frac{1}{2}-2\frac{3}{4}=?$	$8-6\frac{11}{12}=?$	$2\frac{5}{8}-1\frac{5}{12}=?$

XII

34	56	25	72	69	52	89	79	58	63	19	98	97	49
×8	×8	×9	×4	×5	×6	×2	×9	×8	×6	×6	×4	×8	×7

38	62	78	87	54	89	69	52	94	99	37	29	67	93
×9	×8	×7	×5	×4	×3	×4	×7	×9	×4	×6	×3	×8	×4

XIII

5624	9389	5158	3528	6809	9807
×18	×79	×42	×35	×69	×91

XIV

424	35.8	6.98	25.4	8.75	.256
×.36	×.42	×64	×.035	×.028	×.74

XV

	a	b	c
1.	$\frac{3}{4}\times 84=?$	$64\times\frac{5}{8}=?$	$\frac{3}{8}\times\frac{5}{12}=?$
2.	$\frac{2}{3}\times 58=?$	$3\frac{1}{2}\times 2\frac{3}{4}=?$	$\frac{2}{3}\times 7\frac{1}{2}=?$
3.	$\frac{2}{3}\times\frac{3}{24}=?$	$\frac{1}{2}\times 12\frac{1}{2}=?$	$\frac{3}{8}\times\frac{1}{2}=?$
4.	$2\frac{1}{2}\times 2\frac{1}{2}=?$	$\frac{2}{3}\times 37\frac{1}{2}=?$	$\frac{5}{12}\times 84\frac{1}{3}=?$

XVI

45239	53429	60871
×278	×951	×273

XVII

39245	87160	71608
×436	×916	×845

NOTE.—Exercises XVI and XVII contain all the multiplication facts.

XVIII

$2\overline{)418}$	$5\overline{)465}$	$3\overline{)798}$	$4\overline{)392}$	$2\overline{)378}$
$7\overline{)574}$	$6\overline{)978}$	$9\overline{)873}$	$8\overline{)752}$	$7\overline{)504}$
$9\overline{)585}$	$8\overline{)384}$	$7\overline{)623}$	$6\overline{)276}$	$9\overline{)297}$
$3\overline{)879}$	$4\overline{)996}$	$2\overline{)548}$	$5\overline{)860}$	$3\overline{)684}$

XIX

$98\overline{)8036}$	$33\overline{)891}$
$64\overline{)5184}$	$31\overline{)2852}$
$94\overline{)5734}$	$75\overline{)4875}$

XX

$79\overline{)18486}$	$12\overline{)12}$
$26\overline{)15106}$	$.1\overline{)10}$
$51\overline{)25041}$	$8.4\overline{)84}$
$85\overline{)57375}$	$.021\overline{).84}$

XXI

$12\overline{).12}$	$.001\overline{).01}$
$.25\overline{)75}$	$840\overline{)84}$
$21\overline{).84}$	$81\overline{)3.24}$
$.3\overline{)3}$	$.3\overline{).30}$

XXII

	a	b	c
1.	$50 \div 50 = ?$	$50 \div 250 = ?$	$3.5 \div 7 = ?$
2.	$45 \div .9 = ?$	$4.5 \div .9 = ?$	$.02 \div .1 = ?$
3.	$25 \div .25 = ?$	$2.5 \div 25 = ?$	$2.5 \div .25 = ?$

XXIII

$87160\overline{)79838560}$

$71608\overline{)60508760}$

XXIV

	a	b	c
1.	$\frac{3}{4} \div \frac{1}{4} = ?$	$\frac{1}{2} \div \frac{1}{4} = ?$	$\frac{1}{8} \div \frac{1}{4} = ?$
2.	$\frac{3}{4} \div \frac{5}{8} = ?$	$\frac{5}{12} \div \frac{1}{3} = ?$	$\frac{7}{8} \div \frac{1}{2} = ?$
3.	$\frac{3}{8} \div \frac{3}{16} = ?$	$\frac{7}{12} \div \frac{7}{8} = ?$	$\frac{3}{4} \div \frac{1}{3} = ?$
4.	$\frac{1}{2} \div \frac{1}{3} = ?$	$\frac{3}{8} \div \frac{3}{4} = ?$	$\frac{1}{3} \div \frac{1}{2} = ?$

XXV	XXVI
319	77
319	343
81	170
142	22
339	267
320	148
131	274
312	316
320	154
312	81
130	288
291	288
288	342
80	274
80	279
343	285
131	317
293	132
153	189
40	189
338	189

XXVII

908	751	648
762	839	276
273	986	382
537	474	401
154	318	514
891	563	720
389	635	199
616	147	865
445	292	907

XXVIII

1. $325 \div 12\frac{1}{2}$
2. $60 \div 37\frac{1}{2}$
3. $24 \div .33\frac{1}{3}$
4. $728 \times 5.33\frac{1}{3}$
5. $87\frac{1}{2}\% \times 56$
6. 144×25
7. $\frac{1}{3} + 66\frac{2}{3}\%$
8. $62\frac{1}{2}\% - \frac{1}{4}$
9. $37\frac{1}{2}\% + \frac{7}{8}$
10. $33\frac{1}{3}\% + .66\frac{2}{3}$

XXIX

1. $(25\% \times 90 \text{ ft.}) + (25\% \times 32 \text{ ft.}) = ?$
2. $(15\% \times \$24) - (10\% \times \$24) = ?$
3. $(12 \times \$7) + (8 \times \$7) - (5 \times \$7) = ?$
4. $(8 \times 12\frac{1}{2}¢) + (16 \times 12\frac{1}{2}¢) + (24 \times 12\frac{1}{2}¢) = ?$
5. $(\$8.75 \times 6) - (\$8.75 \times 4) = ?$

XXX

Divide each of these numbers by 9, writing the quotient and remainder only.

	a	b	c	d	e	f	g	h
(1)	1.2	2.5	2.7	3.4	2.8	1.9	3.5	1.8
(2)	.15	.26	.19	.22	.18	.16	.24	.32
(3)	.018	.042	.036	.022	.024	.033	.042	.015

Place the decimal point where it belongs in each of the next two exercises. Write the answers on another sheet.

XXXI

1. $3.4 \times 6.5 = 2210$
2. $.68 \times .75 = 5100$
3. $4 \times .96 = 384$
4. $.04 \times 9.6 = 384$
5. $.025 \times .25 = 625$
6. $.4 \times .08 = 32$
7. $.07 \times .008 = 56$
8. $64 \times .64 = 9096$
9. $12.5 \times 125 = 15625$
10. $13.5 \times 1.35 = 18225$
11. $75 \times 75 = 5625$
12. $.65 \times 65 = 4225$
13. $6.5 \times .650 = 42250$
14. $23.5 \times 2.5 = 5875$
15. $34 \times .034 = 1156$
16. $88.2 \times .81 = 71442$
17. $3.45 \times .09 = 3105$
18. $.03 \times 500 = 1500$
19. $3004 \times .004 = 12016$
20. $3.1416 \times 40 = 1256640$
21. $.26 \times 3.75 = 9750$
22. $.01 \times .001 = 1$
23. $100 \times .0001 = 100$
24. $.002 \times 2000 = 4000$
25. $.002 \times .005 = 10$
26. $.016 \times 1.6 = 256$

XXXII

1. $\begin{array}{r}275\\27.5\overline{)756.25}\end{array}$
2. $\begin{array}{r}275\\275\overline{)756.25}\end{array}$
3. $\begin{array}{r}275\\2.75\overline{)75.625}\end{array}$
4. $\begin{array}{r}275\\.275\overline{)7.5625}\end{array}$
5. $\begin{array}{r}275\\275\overline{)7.5625}\end{array}$
6. $\begin{array}{r}275\\27.5\overline{)7.5625}\end{array}$
7. $\begin{array}{r}275\\275\overline{)7562.5}\end{array}$
8. $\begin{array}{r}275\\2.75\overline{)75625}\end{array}$
9. $\begin{array}{r}275\\.275\overline{)756.25}\end{array}$
10. $\begin{array}{r}275\\27.5\overline{)75625}\end{array}$
11. $\begin{array}{r}275\\27.5\overline{).75625}\end{array}$
12. $\begin{array}{r}275\\275\overline{)75.625}\end{array}$
13. $\begin{array}{r}275\\2.75\overline{)756.25}\end{array}$
14. $\begin{array}{r}275\\.275\overline{)75.625}\end{array}$
15. $\begin{array}{r}275\\2.75\overline{)7.5625}\end{array}$

XXXIII

10 right in 8 minutes.

359	803	597	908	751	648	205
235	924	383	762	839	276	110
714	652	708	273	986	382	324
129	260	227	537	474	401	638
647	545	474	154	318	514	411
280	381	566	891	563	720	539
486	769	690	389	635	199	747
592	827	815	616	147	865	156
678	138	189	445	292	907	200

586	170	215	245	864	319	932
324	676	787	306	977	985	749
247	505	478	498	590	758	288
174	237	196	589	745	264	539
958	458	509	250	839	437	672
435	722	924	615	986	801	416
913	384	840	824	692	126	284
692	899	382	707	548	598	219
709	968	623	191	704	677	704

XXXIV

These 12 examples contain the 90 subtraction facts. A 7th grade pupil, good in subtraction, should have all right in 5 minutes.

80314927	9562145	93832917	8590323
46349441	9208247	32105144	5962665

8760051	4003347	42754101	7598719
2273528	2712617	32851519	4887916

80802121	76697666	2558496	82364354
65887712	22416569	1412743	35845858

XXXV

10 products right in 6 minutes.

9807	5369	3279	5486	6942
91	28	54	76	430
6309	3528	9158	9389	5624
69	35	42	79	18
7558	3478	3484	3792	3098
83	92	208	57	67

XXXVI

9 right in 8 minutes.

$43\overline{)29283}$	$39\overline{)15210}$	$72\overline{)15264}$	$88\overline{)50336}$
$63\overline{)58275}$	$82\overline{)35424}$	$19\overline{)10146}$	$27\overline{)15660}$
$34\overline{)31960}$	$85\overline{)28645}$	$56\overline{)45304}$	$67\overline{)28877}$

XXXVII

10 right in 3 minutes.

	a	b	c
1.	$\frac{3}{4}+\frac{1}{6}=?$	$\frac{5}{8}-\frac{5}{12}=?$	$\frac{2}{3}\times\frac{3}{4}=?$
2.	$\frac{3}{4}\div\frac{1}{8}=?$	$\frac{5}{6}+\frac{3}{8}=?$	$\frac{7}{8}-\frac{3}{4}=?$
3.	$\frac{5}{8}\times\frac{16}{24}=?$	$\frac{2}{3}\div\frac{5}{12}=?$	$\frac{11}{12}+\frac{2}{3}=?$
4.	$\frac{5}{8}-\frac{3}{16}=?$	$\frac{3}{4}\times\frac{20}{32}=?$	$\frac{3}{8}\div\frac{3}{16}=?$

CHAPTER VI

SAVING TIME IN COMPUTING

A good motto for computers: "Speed, Accuracy, Brevity."

I. In Addition and Subtraction

1. Add in the shortest way.

1	2	3	4	5	6	7	8
$\frac{3}{4}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{7}{12}$	$\frac{3}{4}$	$2\frac{1}{4}$	$6\frac{2}{3}$
$\frac{1}{2}$	$\frac{5}{6}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{3}{4}$	$3\frac{1}{2}$	$2\frac{1}{2}$
$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{7}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$5\frac{3}{4}$	$4\frac{1}{3}$

2. To find the sum of several products when one factor is common, multiply the common factor by the sum of the others.

$$(8 \times 9) + (4 \times 9) = (8 + 4) \times 9 = 108$$
$$(\$\tfrac{3}{4} \times 7) + (\$\tfrac{3}{4} \times 5) = \$\tfrac{3}{4} \times 12 = \$9$$

Write answers only.

1. $(8 \times 3 \text{ ft.}) + (5 \times 3 \text{ ft.}) + (12 \times 3 \text{ ft.}) = ?$
2. $(\$5 \times 16) + (\$5 \times 24) + (\$5 \times 20) = ?$
3. $(5\frac{1}{2} \times 4) + (6\frac{3}{4} \times 4) + (7\frac{1}{4} \times 4) = ?$
4. $(3\frac{1}{3} \times 8) + (3\frac{1}{3} \times 9) + (3\frac{1}{3} \times 13) = ?$
5. $(16 \times 22) + (18 \times 22) + (6 \times 22) = ?$
6. $(34 \times 19) + (34 \times 21) + (34 \times 10) = ?$
7. $(84 \times 56) + (72 \times 56) + (44 \times 56) = ?$
8. $(3 \times 25¢) + (4 \times 25¢) + (3 \times 25¢) = ?$

9. $\$6.20 \times 4 = ?$
$\$6.20 \times 7 = ?$
$\$6.20 \times 9 = ?$
$\$6.20 \times 2\frac{1}{2} = ?$
$\$6.20 \times 7\frac{1}{2} = ?$
$\$6.20 \times ? = ?$

How much do you save in No. 9 by the short method?

3. Change the method just learned so that it applies to these examples.

1. $(\$36 \times 5) - (\$36 \times 3) = ?$
2. $(8\frac{3}{4} \times 6) - (5\frac{1}{2} \times 6) = ?$
3. $(96 \times 4) - (85 \times 4) = ?$
4. $(19 \times 2) - (19 \times 0) = ?$
5. $(6 \times 3 \text{ ft.}) - (4 \times 3 \text{ ft.}) = ?$
6. $(7 \times 2\frac{1}{2}) - (3 \times 2\frac{1}{2}) = ?$
7. $(56 \times 3) - (56 \times 2) = ?$
8. $(24 \times 3\frac{1}{3}) - (21 \times 3\frac{1}{3}) = ?$

II. In Multiplication

1. To multiply any number by 25, divide by 4 and move the decimal point two places to the right.

$86 \times 25 = ?$

Think $4\overline{)86}$ with quotient 21.50   Write 2150.

Multiply each of these numbers by 25. Write the products only.

12	144	48.4	5.6	632	1728	96
18	360	52.8	3.8	728	1960	196
34	528	5.28	8.4	388	508	3.24

Some pupils have changed this method so as to multiply any number by 2.5. Can you?

2. To multiply any number ending in 5 by itself, multiply the part to the left of 5 by one more than itself and annex 25 (5×5) to this product.

$35 \times 35 = ?$ Think 3×4, 5×5.   Say or write 1225.

Write the products.

	a	b	c	d
1.	$85 \times 85 = ?$	$65 \times 65 = ?$	$3.5 \times 3.5 = ?$	$.85 \times .85 = ?$
2.	$95 \times 95 = ?$	$25 \times 25 = ?$	$55 \times 55 = ?$	$9.5 \times 9.5 = ?$
3.	$7.5 \times 7.5 = ?$	$4.5 \times 4.5 = ?$	$2.5 \times 2.5 = ?$	$.35 \times .35 = ?$

Remembering the decimal point in the product, apply the short method on the previous page to these examples.

	a	b	c
1.	$85 \times 8.5 = ?$	$9.5 \times 95 = ?$	$.35 \times 3.5 = ?$
2.	$2.5 \times 25 = ?$	$65 \times .65 = ?$	$7.5 \times .75 = ?$
3.	$65 \times 6.5 = ?$	$45 \times .45 = ?$	$.15 \times 1.5 = ?$
4.	$.55 \times 5.5 = ?$	$95 \times .95 = ?$	$.85 \times 85 = ?$

Use the same method to find the product of two mixed numbers whose integers are the same and the sum of whose fractions is 1.

$8\frac{5}{6} \times 8\frac{1}{6} = ?$ Think 8×9 and annex $\frac{5}{6} \times \frac{1}{6}$. Say or write $72\frac{5}{36}$.

	a	b	c
1.	$3\frac{1}{2} \times 3\frac{1}{2} = ?$	$4\frac{3}{4} \times 4\frac{1}{4} = ?$	$5\frac{2}{3} \times 5\frac{1}{3} = ?$
2.	$7\frac{7}{8} \times 7\frac{1}{8} = ?$	$4\frac{5}{8} \times 4\frac{3}{8} = ?$	$9\frac{5}{12} \times 9\frac{7}{12} = ?$
3.	$11\frac{3}{8} \times 11\frac{5}{8} = ?$	$3\frac{3}{5} \times 3\frac{2}{5} = ?$	$7\frac{1}{4} \times 7\frac{3}{4} = ?$
4.	$8\frac{7}{8} \times 8\frac{1}{8} = ?$	$12\frac{5}{8} \times 12\frac{3}{8} = ?$	$5\frac{3}{4} \times 5\frac{1}{4} = ?$

3. This method may be extended to include the product of any two factors in the same decade the sum of whose ones is 10.

$33 \times 37 = ?$ Think 3×4 and annex 3×7. Say or write 1221.
$58 \times 52 = ?$ Think 6×5 and annex 8×2. Say or write 3016.

	a	b	c
1.	$92 \times 98 = ?$	$22 \times 28 = ?$	$43 \times 47 = ?$
2.	$54 \times 56 = ?$	$55 \times 55 = ?$	$21 \times 29 = ?$
3.	$26 \times 24 = ?$	$16 \times 14 = ?$	$18 \times 12 = ?$
4.	$44 \times 46 = ?$	$73 \times 77 = ?$	$86 \times 84 = ?$
5.	$71 \times 79 = ?$	$72 \times 78 = ?$	$23 \times 27 = ?$

With the help of your knowledge of multiplication of decimals apply the foregoing method to the examples at the top of page 45. Write products only.

	a	b	c
1.	$9.2\times 98=?$	$9.8\times 9.2=?$	$9.1\times 99=?$
2.	$7.8\times 72=?$	$7.2\times 7.8=?$	$34\times 3.6=?$
3.	$7.5\times .75=?$	$63\times 6.7=?$	$.61\times 69=?$
4.	$5.6\times 54=?$	$49\times 4.1=?$	$.42\times .48=?$
5.	$1.7\times 1.3=?$	$3.8\times 32=?$	$2.7\times .23=?$

4. To multiply two mixed numbers whose fractions are $\frac{1}{2}$, add to the product of the two integers half their sum, and to this add $\frac{1}{4}$.

$4\frac{1}{2}\times 6\frac{1}{2}=?$

Think $24 \quad (4\times 6)+5 \left(\frac{4+6}{2}\right)+\frac{1}{4} \quad (\frac{1}{2}\times\frac{1}{2})$. Say or write $29\frac{1}{4}$.

$3\frac{1}{2}\times 8\frac{1}{2}=?$ Think $24+5\frac{1}{2}+\frac{1}{4}$. Say or write $29\frac{3}{4}$.

	a	b	c
1.	$6\frac{1}{2}\times 8\frac{1}{2}=?$	$12\frac{1}{2}\times 4\frac{1}{2}=?$	$7\frac{1}{2}\times 5\frac{1}{2}=?$
2.	$3\frac{1}{2}\times 2\frac{1}{2}=?$	$6\frac{1}{2}\times 12\frac{1}{2}=?$	$9\frac{1}{2}\times 8\frac{1}{2}=?$
3.	$1\frac{1}{2}\times 18\frac{1}{2}=?$	$14\frac{1}{2}\times 6\frac{1}{2}=?$	$10\frac{1}{2}\times 12\frac{1}{2}=?$
4.	$2\frac{1}{2}\times 24\frac{1}{2}=?$	$3\frac{1}{2}\times 9\frac{1}{2}=?$	$9\frac{1}{2}\times 10\frac{1}{2}=?$

5. Save time in this way when either factor is one of these numbers: $12\frac{1}{2}$, $8\frac{1}{3}$, $16\frac{2}{3}$, $33\frac{1}{3}$, $3\frac{1}{3}$, $2\frac{1}{2}$.

$432\times 12\frac{1}{2}=?$

$$8\overline{)43200}\quad 5400$$

Since $12\frac{1}{2}=\frac{1}{8}$ of 100, you can multiply 432 by $12\frac{1}{2}$ in this way.

How would you multiply 432 by $16\frac{2}{3}$? by $33\frac{1}{3}$? by $3\frac{1}{3}$? by 2.5?

Multiply each of these numbers in turn by each of the factors named in number 5.

64	52	57	24	128	144	.36	1728	17.28
16	32	36	48	528	324	.24	172.8	3.68

6. To multiply an integer or mixed number by a fraction or by a mixed number whose numerator is one less than the denominator, multiply by the next larger integer and make the proper subtraction.

$24 \times 8\frac{11}{12} = 216 - 2 = 214$. Subtract $\frac{1}{12}$ of 24 from 9×24.

$16\frac{1}{2} \times \frac{7}{8} = 16\frac{1}{2} - 2\frac{1}{16} = 14\frac{7}{16}$. Subtract $\frac{1}{8}$ of $16\frac{1}{2}$ from $1 \times 16\frac{1}{2}$.

Multiply each of the following by $\frac{3}{4}$, by $\frac{7}{8}$, by $\frac{11}{12}$, by $\frac{15}{16}$, by $2\frac{3}{4}$, by $6\frac{7}{8}$, by $7\frac{5}{6}$, by $8\frac{2}{3}$, by $3\frac{11}{12}$, by $1\frac{15}{16}$.

12	24	32	$15\frac{2}{3}$	48	240	$72\frac{1}{2}$	$66\frac{2}{3}$	144	320	12
14	36	64	$42\frac{1}{2}$	96	1728	$33\frac{1}{3}$	$5\frac{1}{2}$	128	160	18

7. To multiply any number of two digits by 99 or 999

(1) Write the number less one.

(2) To this annex the difference between 100 or 1000 and the number.

(a) $38 \times 99 = 3762$. (b) $56 \times 999 = 55944$.

Multiply each of these numbers by 99, by 999.

48	12	32	34	42	88	92	79
72	24	36	56	94	76	80	40

Apply this method to 9.9 and .99 by having the proper regard for the decimal point.

Thus, $84 \times .99 = 83.16$; $8.2 \times 9.9 = 81.18$; $.86 \times .99 = .8514$.

	a	b	c
1.	$76 \times 9.9 = ?$	$.76 \times .99 = ?$	$9.2 \times .99 = ?$
2.	$7.4 \times 9.9 = ?$	$.72 \times .99 = ?$	$52 \times .99 = ?$
3.	$5.4 \times 9.9 = ?$	$.63 \times 9.9 = ?$	$.65 \times 99 = ?$
4.	$58 \times 9.9 = ?$	$70 \times 9.9 = ?$	$15 \times 99 = ?$
5.	$2.5 \times 9.9 = ?$	$3.5 \times 9.9 = ?$	$45 \times 9.9 = ?$

8. To reduce the number of partial products when the parts of one of the factors bear an easy multiple relation to each other, proceed as shown in the solutions below.

(a) $246 \times 846 = ?$

846	By making 246 the multiplier, the partial products reduce to two. $24 = 4 \times 6$. Multiply by 6. Then this product by 4.
246	
5076	
20304	
208116	

(b) $348 \times 945 = ?$

348	In (b) multiply first by 9. Multiply this product by 5. Why?
945	
3132	
15660	
328860	

Solve by the long method examples (a) and (b) above, then count how many steps in multiplication and in addition you save by the short method.

Following the directions given above, find these products.

	a	b	c
1.	$364 \times 956 = ?$	$981 \times 429 = ?$	$563 \times 328 = ?$
2.	$562 \times 832 = ?$	$872 \times 322 = ?$	$279 \times 252 = ?$
3.	$525 \times 164 = ?$	$356 \times 636 = ?$	$648 \times 758 = ?$
4.	$642 \times 259 = ?$	$864 \times 135 = ?$	$382 \times 459 = ?$

III. In Division

1. To divide any number by 25, move the decimal point 2 places to the left and multiply by 4.

Thus, $36.2 \div 25 = .362 \times 4 = 1.448$.

Divide each of these numbers by 25.

	a	b	c	d	e	f
1.	875	32.6	5	153	7896	48.2
2.	1963	28.2	7	196	9604	53.8
3.	6324	82.7	9	560	7000	62.5
4.	4896	96.3	4	275	6400	58.4
5.	6324	58.5	3	650	8575	36.2

2. To divide by $12\frac{1}{2}$, move the decimal point two places to the left and multiply by 8. Why? How do you divide by $16\frac{2}{3}$? by $33\frac{1}{3}$? by $66\frac{2}{3}$? by 75?

Divide each of these numbers by each of the divisors named in number 2.

24	384	255	8.4	75	35.6	716
36	256	375	9.6	32	48.2	896
18	144	.260	5.4	96	43.2	324

3. To reduce an example in long division to one in short division remove a large common factor from both dividend and divisor.

$\overset{682}{\cancel{2728}} \div \overset{4}{\cancel{16}} = 170\frac{1}{2}$. Remove the common factor 4 from both dividend and divisor.

Review the divisibility tests for 3, 4, 6, 8, and 9.

	a	b	c
1.	$1356 \div 28 = ?$	$18248 \div 72 = ?$	$29840 \div 64 = ?$
2.	$1828 \div 36 = ?$	$92484 \div 27 = ?$	$23205 \div 49 = ?$
3.	$2379 \div 39 = ?$	$16496 \div 24 = ?$	$15681 \div 24 = ?$
4.	$7356 \div 44 = ?$	$69381 \div 63 \div ?$	$74328 \div 36 = ?$

4. When the divisor ends in one or more zeros, cancel these zeros and move the decimal point of the dividend as many places to the left as there are canceled zeros.

How many tons in a carload of coal weighing 34640 lb.?

$$\begin{array}{r} 17.32 \\ 2\cancel{0}\cancel{0}\cancel{0})\overline{34.640} \end{array}$$

There are 17.32 tons.

Solve these examples by the method just shown.

	a	b	c
1.	$3484 \div 80 = ?$	$65182 \div 60 = ?$	$43242 \div 70 = ?$

2. $42860 \div 2000 = ?$ $\quad 96420 \div 2240 = ?$ $\quad 75630 \div 2240 = ?$
3. $9652 \div 40 = ?$ $\quad 73482 \div 440 = ?$ $\quad 84320 \div 80 = ?$

5. Cancellation with decimals.

You can remove common factors and cancel with decimals in the same way as with whole numbers if you watch the decimal point. Study this solution. Then solve the next examples by cancellation.

$$\frac{\overset{\cancel{14}}{\cancel{.84}}\times\overset{.03}{\cancel{.75}}\times\cancel{16}}{\underset{\cancel{.06}}{\cancel{.96}}\times\underset{.1}{\cancel{2.5}}\times\underset{.1}{\cancel{1.4}}}=\frac{.03}{.01}=3$$

1. $\dfrac{.40\times64\times.75}{25\times.4\times.80}$ $\qquad$ 4. $\dfrac{6.4\times32.8}{144}$

2. $\dfrac{.60\times.70\times\$120}{.90\times.80\times\$100}$ $\qquad$ 5. $\dfrac{16.4\times2.4\times3.6}{1728}$

3. $\dfrac{35\times84\times60}{.90\times2.8}$ $\qquad$ 6. $\dfrac{4.2\times3.5\times4.4\times1728}{231}$

IV. Examples for Practice

Each of these examples can be solved without written work by selecting the proper short method. Find it. Then write the answer.

	a	b	c
1.	84×25	39×21	$1.8\times\$60$
2.	$96\times33\frac{1}{3}$	199×7	$.19\times300$
3.	$\$21.25\times40$	$.02\frac{1}{2}\times1600$	$2\frac{1}{2}\times2\frac{1}{2}$
4.	800×31	$.03\frac{1}{3}\times900$	$144\div12\frac{1}{2}$
5.	65×65	$.96\frac{2}{3}\times30$	35×35
6.	$5\frac{1}{2}\times5\frac{1}{2}$	$101\%\times80$	125×64
7.	$1200\times1\frac{3}{4}$	$125\%\times36$	$133\frac{1}{3}\%\times600$

	a	b	c
8.	$\$15.75 \times 20$	$11 \times \$480$	$125\% \times 12$
9.	$16\frac{2}{3} \times 180$	$25 \times \$75$	$200\% \times \$53.50$
10.	$16\frac{2}{3}\% \times 12$	$\$75 \times 75$	$.00\frac{1}{2} \times \$1000$
11.	$16\frac{2}{3} \times 84$	$85 \times \$85$	$\frac{3}{4}\% \times 1600$
12.	$12\frac{1}{2} \times 64$	24.75×4	$.05\% \times 10000$
13.	$12\frac{1}{2}\% \times 840$	$25\% \times \$400.40$	$175\% \times 28$
14.	$1200 \times 66\frac{2}{3}$	99×640	150×150
15.	$99\% \times 200$	$84 \div 25$	$25 \times .25$

V. Applications of Short Methods

Use your knowledge of short methods to solve these problems.

The following table shows the estimated consumption and cost of various articles of food furnished our army in one year of the recent war.

Estimate the cost per lb., and then solve to four decimal places to determine how close your estimate is. Prove your result.

Article	Quantity in Lb.	Cost	Cost per Lb
Fresh Beef	478,515,000	$109,627,786.50	?
Bacon	48,180,000	18,587,844	?
Lard	6,570,000	1,729,881	?
Lard Substitutes	31,755,000	6,670,222.50	?
Butter	15,330,000	6,516,783	?
Corn Meal	24,090,000	1,211,727	?
Rice	30,660,000	2,158,464	?
Potatoes	782,925,000	14,014,357.50	?
Onions	58,035,000	1,439,268	?
Coffee	61,320,000	9,265,242	?
Total	?	?	

CHAPTER VII

COMMON BUSINESS FORMS, PRACTICES, AND PROBLEMS

Bank Checks

1. A check is an order on a bank, in which the signer of the check has a deposit, to pay a certain sum of money not greater than the deposit to some one named in the check.

No. *86* Lansing, Mich., *July 7, 1920.*

OAK GROVE BANK
OF LANSING, MICH.

Pay to the order of *Polar Wave Ice Co.* $ *4 75/100*

Four and 75/100 Dollars

John Jackson

CHECK

2. What will the Polar Wave Ice Co. do with this check?

3. When the check comes to the Oak Grove Bank, it is charged to John Jackson's account and is marked paid. It is now a canceled check and is finally returned to John Jackson. It serves as a receipt because it has the signature of the Polar Wave Ice Co. on the back of it.

4. Why should a canceled check be kept?

5. Arthur McCoy of Valley Park, Mo., bought a suit for $20 from the Model Clothing Co. in his home town and paid for it with his check. Write it.

Salesman's Checks or Slips

Buyer *Miss Mary Adams*
3733 Hartford St.

Salesman *W. Y.* Date *12/23/20*

FAMOUS CLOTHING COMPANY
Indianapolis, Ind.

1 pair shoes	*$ 6.50*	Amt. rec'd	*$20.00*
1 traveling bag	*12.00*		
			18.50
		Change	*1.50*
			$20.00

In case of error, please return this slip

A SALESMAN'S SLIP

1. A form like the above is filled out by the salesman in duplicate by means of carbon paper at the time the sale is made. One copy is given to the buyer. The other is kept by the store as a record of the sale.

2. Study the above form to learn what it should contain.

3. Make a cash sales slip in which you are the clerk and your teacher is the buyer of certain books and paper.

4. What advantages are there in dealing at a store which sells for cash only? Is there any disadvantage?

Invoices

An itemized statement of goods sold by a manufacturer or a wholesale dealer at one time or on one day is an invoice.

				Ithaca, N. Y., *2/3/20*		
J. A. DODGE Louisville, Ky.						
	To *Comstock Publishing Co.,* Dr.					
TERMS: Net Cash						
Sent by ppd. exp.						
160	*Tree Note Books*		*30¢*	*$48*		
100	*Bird " "*	*No. 1*	*30¢*	*30*		
10	*" " "*	*No. 2*	*30¢*	*3*		
					81	
			Less 1/3		*27*	
					$54	

AN INVOICE

The heading should contain the names and addresses of the parties to the sale, the terms of the sale, and its date. The body should contain the name, quantity, and price of each article, the total selling price of each item, and the total sale.

Filling in the total of each item is called extending the invoice; finding the total of the invoice is called footing it. Study the form on this page and then answer these questions.

1. What does less $\frac{1}{3}$ mean?

2. When should the above invoice be paid?

3. Write a proper check in payment of it.

4. Compare the above invoice with the sales slip on page 52. How are they alike? How different?

5. Write the invoice for this transaction. The Grand Rapids Furniture Co., Grand Rapids, Mich., sold to H. M. Brown & Co., 1629 Olive St., St. Louis, Mo., on Mar. 23,

1920, the following bill of goods: 6 dining tables @ $25, less 15%; 3 doz. dining chairs @ $50.00, less 20%; and 18 brass beds @ $12.00, less 20%. Terms*, 3/10, 1/30, n/60.

What was the net amount of the invoice if paid on April 1, 1920? What if paid on April 21? On May 20?

* Terms: 3/10, 1/30, n/60. This means that the buyer may take a discount of 3% if he pays in 10 days, or 1% if he pays in 30 days, or must pay "net" (i.e., without discount) if he waits longer than 30 days. He must pay in 60 days.

6. Write the check for this invoice if it was paid Apr. 21.

7. Make an invoice for goods purchased from some wholesale dealer by yourself as buyer for some retail store in your community.

Bills

1. A bill* is a formal, written statement of amount due for service rendered, or for service rendered and materials furnished, within a designated time.

St. Louis, *Apr. 19, 1920.*

J. A. Ray

To **UNION ELECTRIC LIGHT CO.,** Dr.

For electric service from March 18 to April 18.

GROSS BILL	Net bill if paid on or before Apr. 28, *$1.10*
14 Kilowatt hours, *$1.15*	

A BILL

* NOTE.—The term BILL is also used to indicate a SALES CHECK, an INVOICE, a STATEMENT OF ACCOUNT, a PIECE OF CURRENCY, a DRAFT, a LEGISLATIVE MEASURE, a PIECE OF PAPER. In this chapter it is deemed proper to restrict it to the definition above.

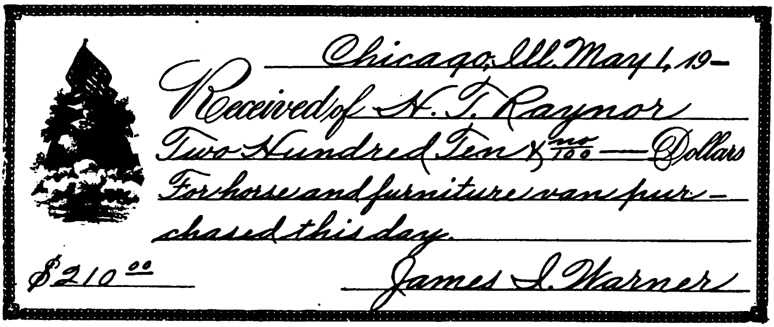
2. Mrs. John White used 8200 cubic feet of gas from Jan. 15 to Feb. 15, furnished by The Peoples Gas Co. at 90¢ per 1000, subject to a discount of 10% if paid within 10 days. Make a proper bill for this service.

3. John Abel, a carpenter, worked $1\frac{1}{2}$ days at $4 per day repairing Mrs. Adam Smith's porch. He furnished lumber and other material amounting to $5. Write the bill.

4. When Mrs. Smith paid the bill in problem 3, she required Mr. Abel to write the word **Paid** on the bill and sign his name. This is called receipting the bill.

Receipts

1. In all cases where money is given in payment of a debt, a receipt should be requested.


Chicago, Ill. May 1, 19—
Received of H. T. Raynor
Two Hundred Ten & no/100 — Dollars
For horse and furniture van pur-
chased this day.
$210.00 James S. Warner

A RECEIPT

2. Study the above form and then state the important parts of a good receipt.

3. Ralph Parker paid Alva Smith $35 for the rent of his house for one month. Write a proper receipt for this transaction.

The Cash Account

Debit the account with all money Cash receives. Credit the account with all money taken from Cash.

1920	*Dr.*	*Cash*	*1920*		*Cr.*
Apr. 1	*To Bal. on Hand.*	*$12.50*	*Apr. 3*	*By Clothing (Shoes)....*	*$ 4.50*
" 6	*" Wages (working after school and Sat.)*	*8.00*	*" 8*	*" Amusement (Movies)*	*.15*
			" 11	*" Church (Contribution)..............*	*.25*
			" 12	*" Balance...........*	*15.60*
		20.50			*20.50*
" 12	*To Bal. on Hand.*	*15.60*			

The account may be balanced at any time. To balance the account is to find how much must be added to the smaller side to make it equal to the larger one. This amount with the word *Balance* is written on the smaller side in red ink, preferably. This amount is then written on the larger side as Balance on Hand.

1. Rule a small blank book like the form above, or buy one ready ruled, and keep an account with your cash. Why should boys and girls keep a cash account?

2. Get permission from your mother to keep the grocery and meat accounts for the family. Call one account Groceries; the other, Meats.

3. A girl received during April $2.50 for helping at home and $1.50 for taking care of the neighbor's little child. She paid during the month 30¢ for amusements, 75¢ for a book, 25¢ for a handkerchief, and contributed 20¢ to Sunday School. If she had $2.15 on hand April 1, write her cash account and find the balance April 30.

An account may be kept with a person in the same way the Cash Account is kept. Charge (debit) the person with everything you do for him. Credit him with everything he does for you.

1920	*Dr.* *Frank Fox*		*1920*		*Cr.*
Mar. 1	*To Balance ......*	*$15.60*	*Mar. 5*	*By Cash ....*	*$12.00*
" 8	*" Labor 5 days @ $1.90 .....*	*?*	*" 12*	*" 6 bu. wheat @ $2.00*	*?*
" 15	*" Labor 5½ days @$2.00 ......*	*?*	*" 18*	*" Cash for Balance ...*	*?*

1. Who is keeping the Frank Fox account?
2. Explain the meaning of **To Balance** on Mar. 1.
3. Who performed the labor debited Mar. 8?
4. Who received the wheat on Mar. 12?
5. What kind of record of the above transactions would Frank Fox keep? How would he name the account?
6. Write the proper receipt which might be required on March 18.
7. Write the proper check for the Mar. 5 item.
8. Write Isaac Miller's account as it would appear on your book from the following transactions during October, 1920.

Oct.	2	Sold him merchandise amounting to $65.75.
"	6	Miller gave his note for $40, due Nov. 5.
"	10	" returned mdse. valued at $2.50.
"	15	Sold him mdse. amounting to $40.25.
"	15	Received $30 cash on account.

(1) Find the balance of the account Oct. 30.
(2) Write the note given Oct. 5.
(3) Write the check given Oct. 15.

Statements

A record of all sales for which cash is not received at the time of the sale, is placed in the customer's account on the books of the store. Usually at the end of the month a statement is sent to the customer. This statement is in fact a copy of the customer's account on the books of the store for the period it is made.

Such a statement should show these items:

(1) the condition of the account at the time the last statement was rendered, if the account is not new;

(2) the various dates on which additional charges were made and the amount of each;

(3) the various dates on which credits were allowed and the amount of each; (4) the balance due.

It need not show the details of the purchases because these are shown on the separate invoices and sales slips.

A customer with a charge account should keep all the salesman's slips for the month in order to compare with the statement sent him at the end of the month.

Chicago, Ill., *Jan. 31, 1921.*

James Bush

1284 Harrison St., Chicago, Ill.

IN ACCOUNT WITH **H. T. RAYNOR**
364 Wabash Avenue

Jan. 8	*To Mdse.*	*$50.65*	
" *20*	" "	*10.25*	
			$60.90

A STATEMENT

Chicago, Ill., *Feb. 28, 1921*

James Bush

1284 Harrison St., Chicago, Ill.

IN ACCOUNT WITH **H. T. RAYNOR**

364 Wabash Avenue

Jan. 31	*To Statement Rendered*	*$60.90*	
Feb. 5	*" Mdse.*	*15.40*	
" 12	*" "*	*6.25*	
			$82.55
CREDITS			
Feb. 3	*By Cash*	*$60.00*	
" 18	*" Mdse. returned*	*1.25*	
			61.25
Feb. 28	*Balance due*		*21.30*

Rec'd payment Mar. 3, 1921. H. T. Raynor.

Study both of H. T. Raynor's monthly statements to James Bush and then answer these questions.

1. Why is the item "To Statement rendered" omitted from the first of Raynor's monthly statements on page 58?

2. How do you find the balance due in the statement on this page?

3. The second statement is a receipted statement. What does this mean? Is a receipted statement necessary if payment is made by check? Why?

4. Write a monthly statement which the grocer might send to your father or mother.

The Inventory

An itemized list of property showing its value is called an **inventory.** The valuation is based on the cost of the property or on its value at the time the inventory is made.

1. The inventory below shows the property in one room in the home of Mr. J. O. Summers. Find the value of all the question marks.

Item	Value
1 *Morris chair*	*$15*
1 *Rocker*	*7*
1 *Straight back chair*	*4.50*
1 *Box couch*	*15.00*
Contents of box couch	*60.00*
1 *Rug 9'x12'*	*18.00*
2 *Sectional book cases @ $22.50*	*?*
1 " " *case*	*15.00*
2 *Small book stands @ $2.50*	*?*
3 *Taborets @ $3*	*?*
1 *Library table*	*25.00*
140 *Books @ $1.25*	*?*
200 " *@ 75¢*	*?*
Pictures on the wall	*60.00*
Total	*?*

AN INVENTORY

2. Make an inventory of all your personal possessions; such as, books, pictures, clothing, money, etc.

3. Make an inventory of the property in your home, or in one room of your home.

4. If insurance is carried on household contents, the owner should have an inventory of the property in some safe place. Why?

5. Merchants make an inventory of their stock once or twice a year. Why?

6. Make an inventory of all the school property belonging to the children in your schoolroom. Make an inventory of all the school property belonging to the board of education in your schoolroom.

Contracts

An agreement (usually written) made by two or more persons to do or not to do within a certain time some lawful thing is called a contract.

Contracts may follow the form shown below.

Contract Between Harry Ross and Henry Hess

This agreement made on the thirtieth day of October, 1920, between Harry Ross of the city of Columbus, state of Ohio, and Henry Hess of the same city and state, witnesseth: That the said Harry Ross agrees to build daily the furnace fire in the basement of the home of said Henry Hess and to do all the necessary work to keep such furnace in proper heating condition from November 1, 1920, to April 30, 1921.

In consideration of the services so performed, the said Henry Hess agrees to pay to the said Harry Ross Ten Dollars at the close of each month during the term of this contract.

In witness whereof, we have placed our signatures to this contract on this thirtieth day of October, 1920.

Witness: **Harry Ross**
John James **Henry Hess**

1. Write a contract between yourself and your neighbor to cut the grass on his lawn from May 1 to October 1.

2. Why is a written contract better than an oral agreement?

Making a Pay Roll

In the following pay roll of The American Furnace Company find each man's pay and the total pay roll for the week.

Name	M.	Tu.	W.	Th.	F.	S.	Total Hours	Per Hour	Amt.
Brod, Chas.	10	10	10	10	8	9	?	$0.40	?
Buck, Joseph	10	9	10	10	8	10	?	.25	?
Carnes, Harry	7	10	10	10	6	10	?	.25	?
Currie, D. W.	10	10	9	8	8	10	?	.37½	?
Dunn, G. A.	7½	10	8	8	8	10	?	.16½	?
Duroll, Chas.	10	10	10	10	8	10	?	.16½	?
Franks, V. D.	8	10	10	10	8	10	?	.16½	?
Free, Jerry	10	10	8½	10	7	10	?	.66	?
Smith, John	10	5	8	10	8	10	?	.16½	?
White, Harry	8	8	8	8	8	8	?	.33	?
Wilson, Wm.	8	7	6	8	8	8	?	.33	?
Wilson, Loy	8	7½	8	8	8	8	?	.37½	?
							Total		?

Memorandum for the Pay Envelope

After the pay roll is made as shown above, the number and value of each bill and coin to be placed in each man's pay envelope are determined as shown in the table begun below. Complete it. Find a way to check the correctness of your work.

	$10	$5	$2	$1	50¢	25¢	10¢	5¢	1¢	Total
Brod, Chas.	2		1		1	1		1		$22.80
Buck, Joseph	1			4		1				14.25

Memorandum of Pay Roll for the Bank

THE PEOPLES TRUST AND SAVINGS BANK
of Chicago

Bank Memorandum of Pay Roll
for

The American Furnace Co.

Date ______________

	Dollars	Cents
Twenties		
Tens		
Fives		
Twos		
Ones		
Halves		
Quarters		
Dimes		
Nickels		
Pennies		
Total		

This memorandum is prepared to assist the bank teller or cashier in providing the company with the change required for each man's pay envelope.

1. On a separate sheet complete the form shown here for the pay roll on page 62.

2. Write the check which must accompany this memorandum. On which bank is this check drawn? Who signs it?

As the men are handed their pay envelopes each must sign a receipt for the money received. Write Loy Wilson's receipt. Loy Wilson's name is last on the pay roll on page 62.

Make the memorandum for the pay envelopes and from it the bank memorandum for this pay roll.

Name	Amt. Due	Name	Amt. Due	Name	Amt. Due
W. Hill.....	$25.85	H. Daly....	$27.65	M. Fisher..	$29.63
T. Brown...	33.69	Frank Fry..	32.78	C. Stout...	30.26
J. Sanford..	20.46	J. Sands...	36.84	F. See.....	20.85

Business Problems

1. Herbert Smith painted John Ryder's house. Write the bill which is to contain the following items: 3 days' labor of 3 men at $5.50 each per day; paint and other materials, $40. Write the check which John Ryder gave in payment of the bill.

2. Mrs. Alva Smith worked at dressmaking for Mrs. Mary Payne $2\frac{1}{2}$ days at $2.50 a day, and car fare which cost 7¢ a trip. Write the receipt which Mrs. Payne should request when payment was made in full in cash.

3. Write in good English how you would find the amount of cash a person has on hand if it is known: (a) how much cash there was on hand when the account was begun; (b) how much cash was received since that time; (c) how much cash was paid.

4. On September 1, 1920, A. L. Black had on hand $40.60. His receipts and payments of cash during the month were as follows: Sept. 2, received $10.25; Sept. 3, paid $2.24; Sept. 6, received $17.68; Sept. 8, paid $4.50; Sept. 10, received $23.75; Sept. 15, received $1.72; Sept. 16, paid $4.83; Sept. 18, paid $4.50; Sept. 21, received $43.25; Sept. 22, paid $2.50; Sept. 23, paid $2.50; Sept. 24, paid $2.50; Sept. 25, paid $2.50; Sept. 26, received $2.50; Sept. 27, paid $2.50. Write the cash account for the month and find the balance Sept. 30.

Make the invoice, deduct the discount, and write the check for each of the next two problems.

5. On Jan. 31, 1921, James Carver, Joplin, Mo., bought of the Hollis Lumber Co., Kansas City, Mo., 36 doors at

$3.75 each; 18 doors at $6.57 each and 12 doors at $12.50 each. Terms: 5% 10 days, net 60 days.

6. On April 30, 1920, L. F. Hayes, Louisville, Ky., bought of the R. Y. Crowell Co., Wabash, Ind., 500 yd. silk at $1.80; 750 yd. gingham at 75¢; 300 yd. ribbon at 30¢. Terms: 3/10, n/60.

7. Paul Jolly contracted to work for Henry Snyder for one year for $720 and board, the wages to be paid in equal installments at the end of each month. Supply the other necessary data and write the contract.

8. Guy Lenocker, a scientific Iowa farmer, harvested 80 acres of wheat which yielded 30 bu. per acre. The cost of producing and marketing the crop was as follows: plowing and harrowing, $4.25 per acre; seed, 1½ bu. per acre, at $2.50 per bu.; sowing, $0.25 per acre; harvesting, $1.50 per acre; threshing, 6¢ per bu.; hauling to market, 5¢ per bu. He sold the wheat at $2.00 per bu.

The land on which the wheat grew was valued at $140 per acre. He charged the wheat crop 6% interest on the value of the land, also the tax which was $1.25 an acre.

(1) Put the above facts into proper form under the title, "Account with Field No. 5."

(2) Close the account after the wheat was marketed.

(3) What was the entire cost of producing one bushel of wheat in "Field No. 5"?

(4) What were the net earnings of the field?

(5) Compute the net earnings at the current price of wheat.

CHAPTER VIII

PERCENTAGE

The per cent sign (%) after a number, the decimal fraction, and the common fraction are three ways of indicating one or more of the equal parts of a whole. In order to solve percentage problems quickly, very often without pencil, it is worth while to know the decimal and common fraction values of the following per cents.

1. $50\% = .50 = \frac{1}{2}$
2. $25\% = .25 = \frac{1}{4}$
3. $75\% = .75 = \frac{3}{4}$
4. $12\frac{1}{2}\% = .12\frac{1}{2} = \frac{1}{8}$
5. $37\frac{1}{2}\% = .37\frac{1}{2} = \frac{3}{8}$
6. $62\frac{1}{2}\% = .62\frac{1}{2} = \frac{5}{8}$
7. $87\frac{1}{2}\% = .87\frac{1}{2} = \frac{7}{8}$
8. $33\frac{1}{3}\% = .33\frac{1}{3} = \frac{1}{3}$
9. $66\frac{2}{3}\% = .66\frac{2}{3} = \frac{2}{3}$
10. $16\frac{2}{3}\% = .16\frac{2}{3} = \frac{1}{6}$
11. $20\% = .20 = \frac{1}{5}$
12. $40\% = .4 = \frac{2}{5}$
13. $60\% = .6 = \frac{3}{5}$
14. $80\% = .8 = \frac{4}{5}$
15. $10\% = .1 = \frac{1}{10}$
16. $90\% = .9 = \frac{9}{10}$
17. $6\frac{1}{4} = .06\frac{1}{4} = \frac{1}{16}$
18. $5\% = .05 = \frac{1}{20}$
19. $4\% = .04 = \frac{1}{25}$
20. $3\frac{1}{3}\% = .03\frac{1}{3} = \frac{1}{30}$
21. $2\frac{1}{2}\% = .02\frac{1}{2} = \frac{1}{40}$
22. $2\% = .02 = \frac{1}{50}$
23. $125\% = 1.25 = \frac{5}{4}$
24. $112\frac{1}{2}\% = 1.12\frac{1}{2} = \frac{9}{8}$

Write the answers to these examples in 2 minutes.

1. 50% of 80 min.
2. 3% of 60 acres
3. 25% of 32 in.
4. $16\frac{2}{3}\%$ of \$96
5. $12\frac{1}{2}\%$ of 72 in.
6. $87\frac{1}{2}\%$ of 48¢
7. $37\frac{1}{2}\%$ of 24
8. 4% of \$800
9. 6% of \$150
10. $33\frac{1}{3}\%$ of 18
11. $66\frac{2}{3}\% \times 6$ gal.
12. $87\frac{1}{2}\% \times 24$
13. $2\frac{1}{2}\% \times 40$ yd.
14. $4\% \times \$175$
15. $6\frac{1}{4}\% \times 32$

You need to learn these new terms in percentage: the whole (also called the base), the part (also called the percentage), and the relation of the part to the whole (also called the rate).

Percentage is an application of multiplication of common fractions or of decimal fractions.

1. The whole is either the multiplicand or the product.

2. The relation of the part to the whole (rate) or the whole to the part is the multiplier.

3. The part is either the product or the multiplicand.

In the problem, "Find 6% of \$100," \$100 is the whole, 6% is the relation of the part to the whole, and the part is to be found.

As in multiplication two of the terms are always given to find the third.

Examples for Practice

1. Find 8% of \$20.

8% (multiplier) × \$20 (multiplicand) = \$1.60 (product).

2. \$3 is what % of \$9? The following is another way of stating the question: "By what must \$9 be multiplied to produce \$3?"

\$9 (multiplicand) × ? (multiplier) = \$3 (product).
Multiplier = $\frac{3}{9}$ or $33\frac{1}{3}$%.

3. \$6 is $33\frac{1}{3}$% of how much money?

The question is, "by what must I multiply \$6 (the part) to make the whole?" The money (the whole) = 3 (the relation of the whole to the part) × \$6 (the part). The money = \$18.

In each of these examples think first what is given and what is wanted. Then use the shortest process to get the result. Thus in example 1, think, "$33\frac{1}{3}$% is the multiplier,

$1062 is the multiplicand (whole), the required result is the product (part)." Say or write $354.

1. What is $33\frac{1}{3}\%$ of $1062? Of 954 ft.?

2. $6 is how many % of $9? Of $36?

3. Find 25% of $25, 35% of $35, 45% of $45, 75% of $75.

4. Find $12\frac{1}{2}\%$ of $864, of 1728 cu. in., of 5280 ft.

5. $40 is what % of $50? Of $60? Of $40? Of $30?

6. 125% of $80 = ? $133\frac{1}{3}\%$ of $150 = ?

7. 60 ft. is 25% of how many ft.?

8. 18 qt. is $33\frac{1}{3}\%$ of how many pecks?

9. $3 is what % of $4? $6 is what % of $3?

10. Find 90% of 30 mi., 80% of $65.

11. Find 8% of $24.50, 12% of 840 ft.

12. Find 7% of 52 mi., 9% of 700 in.

13. What % is 2¢ of 10¢? Of $1?

14. What % is 1 qt. of 1 pk.? Of 3 pk.?

15. Find the number if 6% of it is $36, if 3% of it is 3 bushels, if 10% of it is 528 feet.

Everyday Problems

Study each of these problems in the manner explained in the previous exercise, then find the answer by the shortest method you know.

1. A man sold an automobile costing $1200 at a profit of $8\frac{1}{3}\%$ of the cost. Find the profit and the selling price.

2. 45% of a cotton crop of 40 bales, averaging 500 lb., was sold at 25¢ a lb. Find the selling price.

3. In a certain arithmetic test of 24 examples in percentage, John had 18 right and Frank had 15 right. Find

each boy's mark. The correct work of Frank is what % of that of John?

4. Mary had \$64 in her savings account. She withdrew \$16 for clothing. What % of her money did she withdraw? The amount withdrawn was what % of the money left in the bank? What % of \$64 did she have remaining in the bank?

5. In 1918, a teacher whose yearly salary is \$1525 paid \$100 for a one hundred dollar Fifth Liberty Loan bond bearing $4\frac{3}{4}\%$ interest. What % of her salary did she invest? How much yearly interest will she receive?

6. Ruth solved 4 problems, which was $33\frac{1}{3}\%$ of the number yet to solve. How many were there altogether?

7. A merchant sold a pair of slightly damaged shoes for \$6.00, losing 20% of the cost. Find the merchant's cost of the shoes.

8. Ben sold 40 papers on Friday after school, which was $66\frac{2}{3}\%$ of what he sold on Thursday. How many did he sell in the two days?

9. A ball team won 20 out of 32 games played. What % of the games did they lose?

10. Out of a yearly salary of \$3500, a man saves \$1100. What % does he spend?

11. A boy lost 3 of his 24 marbles. What % remained?

12. Charles weighed 64 lb. in June. During vacation he gained 6 lb. What was the % of increase?

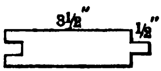
13. Henry weighed 84 lb. before a spell of sickness. After recovery he weighed 80 lb. What was the % of loss?

14. Which is greater and how much, .3 or 3%? $\frac{1}{6}$ or $16\frac{2}{3}\%$? $\frac{1}{2}$ or $\frac{1}{2}\%$? $\frac{3}{4}$ or $.00\frac{3}{4}$?

15. Find $\frac{3}{4}\%$ of \$1200, $\frac{1}{2}\%$ of \$80, $66\frac{2}{3}\%$ of 60 acres. \$10 is $\frac{1}{2}\%$ of how much? Find $\frac{1}{8}\%$ of \$1500. \$15 is what % of \$2000?

16. 10% of a \$20 gold piece weighing 516 grains is alloy. How much pure gold in \$500?

17. A 4-inch floor board with tongue and groove is only $3\frac{1}{2}$ inches wide on its face. In computing the amount of such lumber for a floor, what % must be allowed for the groove?



18. Draw without the aid of a ruler a square inch, a two-inch square, 2 square inches. With the help of the ruler compute your percentage of error.

Problems in Percentage Involving Large Numbers

(Where the answer is to be expressed in per cent, carry it to tenths of a per cent unless otherwise stated.)

1. The Fourth Liberty Loan of \$6,000,000,000 was over-subscribed by \$866,400,000. What was the % of over-subscription? (Carry your answer to hundredths of a per cent.)

2. On March 17, 1919, it was announced that the total expenditure of the United States Government during the war period was \$23,363,000,000. Expenses due directly to the war were estimated at \$21,294,000,000, of which the army spent \$14,000,000,000.

(1) What would have been the normal expenditure for the same period?

(2) What % was the normal expenditure of the total?

(3) Find to hundredths the ratio of the war expense

to the normal expense. Express in per cent the ratio you have just found.

(4) Show with a graph the relation of war to peace as regards cost.

(5) What % was the army cost of the total war cost?

3. On May 15, 1919, the War Department at Washington announced that there were 286,044 casualties in the American Expeditionary Force under General Pershing. Of this number, 237,135 were classed as wounded and the remainder as deaths.

(1) Find what % the deaths were of the total casualties.

(2) What % were the deaths of those wounded?

4. The quota of the Victory Loan was $4,500,000,000. The actual amount subscribed was $5,249,908,300, according to a Washington statement issued May 26, 1919. What was the % of over-subscription?

5. In the autumn of 1916 the Department of Agriculture estimated that the 1917 wheat crop would be 659,797,000 bu. The actual crop was 650,828,000 bu. How nearly accurate in per cent was the estimate?

6. In the autumn of 1916 it was estimated that the 1917 corn crop in the United States would be 3,191,000,000 bu. The actual crop was 3,159,494,000 bu. By what per cent was the estimate wrong?

7. The amount of hay on farms in the United States May 1, 1919, was estimated at 8,493,000 tons as against 11,476,000 tons May 1, 1918. How many % short was the May, 1919, supply of that of May, 1918?

8. On April 1, 1919, the winter wheat crop was estimated at 836,000,000 bushels by the Department of Agriculture. On May 1, 1919, it was estimated at 899,000,000 bushels. Find the % of increase during April.

9. In 1919 the assessed valuation of the real and personal property of a large city was $565,302,070. The state tax commission increased this valuation 15%. What was the total tax valuation for the year?

10. The following table shows the cost to our government of each of the wars waged by the United States.

War of 1812	$ 92,989,000	
Mexican War	117,048,000	
The Civil War	3,091,165,000	
Spanish-American War	718,836,000	
The World War (Apr., 1917 to Nov., 1918)	24,481,000,000	(To April, 1919.)
Total	?	

(1) Construct on the board a bar graph which will show vividly the relative cost of each of the above wars.

HINT.—Let 1 in. of your graph represent $100,000,000.

(2) The cost of the Civil War is what % of the cost of the World War?

(3) The cost of all of the previous wars is what % of the cost of the World War?

(4) What was the monthly cost of the World War to the United States?

(5) Do the amounts above show the real cost of war to our country?

(6) Who pays the cost of the World War?

(7) How is the money raised to meet this debt?

11. The total direct cost of the World War amounts to about $180,000,000,000, of which Germany spent $39,000,000,000; Great Britain, $38,000,000,000; France, $26,000,000,000; and the United States, $22,000,000,000. Represent this condition with a circle graph.

HINT.—Two degrees of arc represent $1,000,000,000.

How will the nations pay for this large expenditure of money? Do the sums above represent the **total** cost of the war?

12. A man paid $2000 for an automobile. The state and city licenses cost $5 each. The tax was $2.25 per $100 on an assessed valuation of $1000. His expenses for repairs for the year were $60.50; for oil $10.20; for gasoline 480 gallons at 20.4¢. He estimated the depreciation for the year at 25% of what he paid for the machine. He ran 5760 miles.

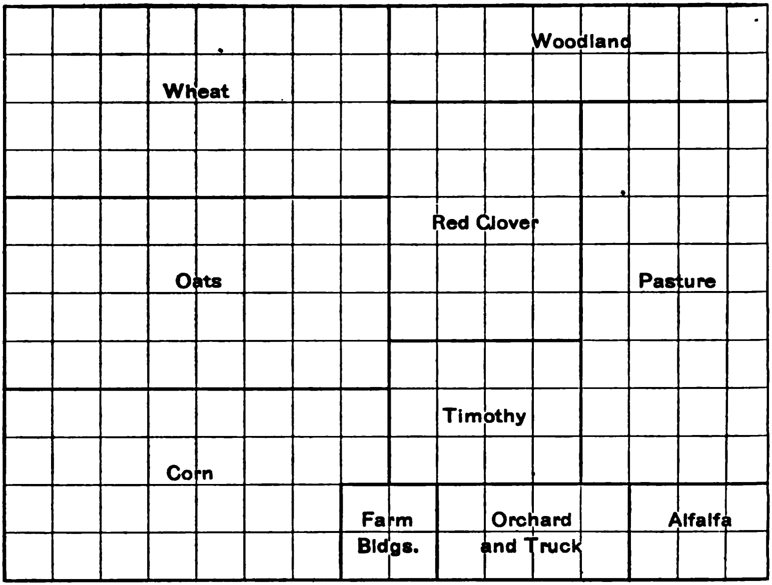
(1) What was the average running cost per mile?

(2) How much mileage per gallon did he get out of his gasoline?

(3) If the machine carried, on an average, 4 persons on every trip during the season, find the mileage cost per passenger.

(4) Did the owner omit any item of importance in estimating the total cost of his machine for the year?

13. A good record for a 7th grade girl in the 50-yard dash is 7.8 seconds; a good record for the same girl in the 100-yard dash is 15.4 seconds. What is the difference in speed per second in the two races? Express your answer in yards and in per cent.



Scale 10 rd.=¼in.

1. Find the area in acres of the farm represented by the above oblong, whose dimensions are 4 in. by 3 in.

2. What per cent of an acre is shown by each square?

3. What per cent of the farm is in woodland? in wheat? in oats? in corn? in timothy? in red clover? in pasture? in alfalfa?

4. What per cent of the farm is in orchard and truck garden?

5. What per cent do the farm buildings occupy? Prove this answer by finding it by another method.

6. Add the per cents found in Nos. 3, 4, and 5. What should the total be?

A piece of ground in the form of an oblong is 100 ft. by 40 ft. It has a walk 4 ft. wide running lengthwise through the middle. Each half is used for a vegetable garden. One half of each half is planted in tomatoes and potatoes. One half of each remaining half is planted in peas and beans. One half of what remains is planted in carrots, parsnips, and turnips; the other half is planted in cabbage, kohlrabi, and Swiss chard.

1. Draw the oblong to the scale 4 ft. = $\frac{1}{4}$ in., showing the garden described above.

2. Find the perimeter of the oblong.

3. Find the length of the garden border.

4. What % is the walk of the oblong? What % is it of the garden?

5. What % is each half of the garden of the oblong?

6. The part planted in peas and beans is what % of the part planted in tomatoes?

7. What % of the whole oblong is planted in cabbage, kohlrabi, and Swiss chard?

8. The part planted in tomatoes is what % of the part planted in potatoes?

9. What % of the whole oblong is planted in peas and beans?

10. What is the ratio of the oblong to the walk?

11. Find the area in square feet of the garden without the walk. What fractional part of an acre is this? Change your answer to per cent.

CHAPTER IX

USING PERCENTAGE

Buying and Selling at a Loss or a Gain

1. A man sold a house and lot costing him $8000 for $9000. What was his rate of gain on the cost? What on the selling price?

2. Business men often compute the rate of profit on the **selling price.** Therefore it is necessary to be able to convert a rate based on the selling price quickly into an equivalent rate based on the cost. Thus, a gain of 25% on the cost is only $\frac{1}{5}$ or 20% of the selling price, which is 125% of the cost.

Proof.—20% of 125% of the cost (selling price) = 25% of 100% of the cost.

3. If the rate of gain on the cost is 20%, what is it on the selling price?

4. John sold his bicycle for $12 at a loss of $16\frac{2}{3}$% of the selling price. What was the rate of loss on the cost?

5. A loss of 20% on the cost is equivalent to what rate on the selling price?

6. If a watch is sold at a loss of $3, which is $12\frac{1}{2}$% of the selling price, find the cost and the rate of loss based on the cost.

7. A gain of $33\frac{1}{3}$% on the cost is equivalent to what rate on the selling price?

8. A man sold two farms for $9000 each, losing 25% of the cost of one and gaining 25% of the selling price on the

other. Find the amount of loss or gain on the entire transaction.

9. A merchant sells umbrellas costing him $1.75 each at $2.50 each. What is his rate of profit computed on the cost? What if computed on the selling price?

10. What is the % of reduction when the selling price of a book is reduced from $2.50 to $2.25?

11. In 1918 good bituminous coal cost $6.00 per ton. In 1919 the same grade cost $5.75. How much more could be bought in 1919 for $6?

12. After gas is reduced from 90¢ per 1000 cu. ft. to 80¢ per 1000 cu. ft., what per cent more can be bought with the same money?

13. Which is the best purchase, apples at 3 for a dime, 50¢ for 15, or 40¢ per dozen?

14. A fruit dealer bought 12 doz. oranges at 25¢ per doz. He lost $8\frac{1}{3}$% of them by decay and sold the rest at 40¢ per dozen. What was his rate of gain on the cost?

15. A merchant marked silk goods costing $2.00 a yard to sell at $2.50. He sold it at 90% of the marked price. Find the rate of gain on the cost.

16. If a dealer sold coal costing him $6 per long ton (2240 lb.), at $6 per short ton (2000 lb.), find his loss or gain on a transaction in which 100 short tons were sold.

17. Find the selling price of a hat costing $3.50 if the store expense is 20% of the cost and the merchant wishes to make 20% on the selling price.

18. When a grocer sells cranberries by the liquid quart at the dry quart price, what is the % of error?

Selling for Another Person

When a farmer has hogs ready for the market, he may either sell them to the local buyer or he may ship them to a large city to some one who will sell them for him.

Such a person is called a **commission merchant,** or **broker.** He is said to do a commission, or a brokerage business. He usually receives a certain per cent of the money he gets for the stock, produce, or other goods sold. This is called his commission or brokerage.

After deducting his commission and such other charges as may have arisen, such as **storage,** or **yardage** in case of live stock, he sends the balance, called the **proceeds** of the sale, to the owner who is called the **principal.** This is called the commission merchant's remittance.

1. An agent sold 154 acres of land at $125 an acre, commission $1\frac{1}{2}\%$. How much did the owner receive for his land?

2. I shipped to my agent at Chicago a car of wheat containing 440 bushels which was sold at $2.20 per bu. (1919 price). The commission was $1\frac{1}{4}\%$; freight, $65. What amount was due me?

3. A commission merchant sold 840 baskets of Concord grapes at 30¢ a basket. The commission amounted to $12.60. Find the rate of commission.

4. A real estate agent sold a ranch in Texas consisting of 42,800 acres of land at $22.50 an acre. How much did the agent receive for his services, his commission being 2%?

5. An Indiana watermelon grower sent 400 melons to his Cincinnati broker. The broker sold 375 melons at an

average of 50¢ a melon. Commission 5%. The others were a loss due to careless handling. The freight was $60. Other charges amounted to $25. What was the average price the grower received for the melons shipped?

6. Find the net amount due the owner from the following sale: 12 carloads of cattle, each car containing 22 head; average weight of cattle, 1200 lb.; price, $12.25 per 100 lb. (July, 1919); commission, $\frac{1}{4}$%; cost of unloading cattle at stockyards, $3.50 per car; freight per car, $108.20.

7. John Smith of Centralia, Ill., shipped on July 1, 1919, 24 head of hogs to his commission merchant at East St. Louis. They were sold on July 2 at $22.15 per 100 lb., the average weight being 242 lb. The commission was 1$\frac{1}{2}$%. Other charges amounted to $25.80. How much money did the commission merchant receive for his services? How much did he send to the owner?

8. I shipped to my agent in Chicago a carload of peaches, 410 bushels, which he sold at $1.25 a bushel. His commission was 8%; freight, $75.65; drayage at Chicago, $8.50. The cost for baskets was $49.20; for picking and packing, $50.20; for carting to station, $18; for refrigeration, $55. How much per bushel net did I receive for my peaches?

9. A fruit grower shipped to a commission merchant a car of apples consisting of 480 boxes, which the merchant sold at $1.25 per box. What were the net proceeds per box, after deducting for commission 2$\frac{1}{2}$¢ per box; freight, $184.30; drayage, $22.50; storage, 5¢ per box? Did the grower have any other expenses? Do you think he received a fair net price for his apples?

Buying for Another

1. In this case the rate of commission is computed on the amount of money the commission merchant pays for the goods. How does this differ from a selling transaction?

2. I instruct my broker to buy 1000 bushels of corn at \$1.40 per bushel, commission 2%. If there are no other charges, what is the corn costing me per bushel?

3. What is a broker's charge for buying 1800 bushels of wheat at $\frac{1}{4}$¢ a bushel?

4. I asked a commission merchant to buy 70 bbl. flour @ \$8.50, commission 2%. How much money must I send him?

5. A man earned \$18 a week collecting gas bills at 1% commission. How much did he collect?

6. An agent paid \$45 an acre for Texas land for his client, charging him 3% commission. How much did the land cost the client per acre?

7. I instruct my agent to buy 1000 bushels of wheat at \$2.20 a bushel. How large a check must I send if the rate of commission is $\frac{1}{2}$%?

Hint.—Find my cost per bushel.

8. Mr. B.'s broker in St. Paul bought 100 barrels of flour at \$10 per barrel, commission 2%. Find the amount of the bill sent to Mr. B.

9. A commission firm bought 100 bales of cotton averaging 500 lb. to the bale at 29¢ a lb. for a speculator, at 2% commission, and in 2 weeks the same firm sold the cotton at 32¢ a lb., commission 2%. Storage and other charges amounted to \$85. Did the speculator lose or gain in the transaction? How much?

Buying at a Discount

1. Certain firms advertise their goods at a list, or catalogue price. Some buyers are allowed a 10% discount from the list. Others are given 10% and 5% off the list; and still others must pay the list price. Who is entitled to the largest discount? Who must pay the list?

2. A and B are neighbors. A buys groceries in quantities, paying cash. B buys in small portions on credit. Can A afford to patronize B's grocer who sells only at credit prices? Why?

3. If I am allowed 5% off for spot cash, or 2% off within 30 days, **when** should I pay if I cannot pay cash? Why?

4. Explain the following statement found on the letter head of a large firm: "Terms: Cash 10%, 10 days 5%, net 30 days."

5. If I am allowed 30 days in which to pay for a bill of goods amounting to $500, how much do I lose by paying spot cash, if I am receiving 6% interest on my money?

6. Young apple trees are listed at 30¢ each or at $3 per dozen. What rate of discount is allowed to the purchaser of a dozen?

7. A merchant paid $450 for an invoice of goods after being allowed a discount of 10%. What was the list price?

8. One firm allows a 25% discount on a lawn mower listed at $6. Another firm lists the same machine at $5, subject to a 10% discount. Which is the better purchase?

9. Goods costing $2 per yd. were sold at a profit of 20% on the cost after dropping 20% from the marked price. What was the marked price?

Successive Discounts

A wholesale dry goods merchant allows 20% and 10% discount on all purchases paid within 30 days. What is the net selling price on an invoice whose list is \$240?

20% and 10% off means that a deduction of 20% is made on \$240 and then a deduction of 10% is made from 80% of \$240. This may be done in three ways.

I. $(100\% - 20\%) \times \$240 = \$192$ second list.
$(100\% - 10\%) \times \$192 = \$172.80$ net selling price.

II. 90% of 80% of $\$240 = \$172.80$. Or 80% of 90% of $\$240 = \$172.80$.

III. Often it is shorter to find a single rate of discount which is the equivalent of the two rates. In the above problem the single rate is 28%. This may be found by subtracting the product of the two discounts from their sum. Thus, $(20\% + 10\%) - 10\%$ of $20\% = 28\%$, the single discount.

Since the single discount in many cases can be seen at a glance, business men often use this method.

1. A dealer buys goods listed at \$75 less 20% and 5%. Find the net price.

The single discount is $(20\% + 5\%) - 5\%$ of $20\% = 24\%$.
The net rate $= 100\% - 24\% = 76\%$.
The net price $= \$75 \times 76\% = \$57$.

2. Which is the better offer, \$200 list less 40% and 30%; or \$200, less 30% and 40%?

HINT.—Find the single discount in each case.

3. One dealer offers a dozen hats at \$72 less 30% and 20%. Another asks \$60 less 20% and 10%. Which is the better offer and how much?

4. A clerk in a wholesale house allowed 30% as the single discount on a $200 bill of goods less 20% and 10%. How much of an error did he make?

5. What is the cost of goods listed at $400, subject to 10% and 5% off?

6. Which is the better offer on an invoice whose list is $800; 10 and 10% off, or 15 and 5% off?

7. A man paid $144 for an invoice of goods after being allowed 20 and 10% off. What was the list price?

8. I purchased goods listed at $500 at 20 and 15% off. I sold them at list, less 10 and 5%. What was my rate of profit based on the cost?

9. Goods listed at $1000 were bought at 25%, 10%, and 5% from the list price and were sold at the list. Find the per cent of gain on the cost, also on the selling price.

10. What per cent profit on the cost is realized by buying at a discount of 20% from the list price and selling at 20% above the list price?

11. Green and Jaeger, wholesale merchants of Chicago, publish a catalog of their hardware every year on Jan. 1. All hardware is listed at retail price. Retail dealers can buy at $33\frac{1}{3}$% off of catalog price. Out-of-town jobbers can buy at $12\frac{1}{2}$% less than the price to retail dealers. Jobbers in Chicago can buy at 10% less than out-of-town jobbers. On June 1 all stoves were reduced 10% from catalog price. How much did Hobart and Company, Chicago jobbers, pay on June 15 for 10 stoves listed at $65.00 each if they were allowed a discount of 2% for cash?

CHAPTER X

PROTECTING ONE'S LIFE AND PROPERTY

1. Mr. Johnson, a painter, fell from a ladder and injured his back so severely that he could not work at his trade for 8 weeks. His employer pays his workmen for the time they are on the job; but Mr. Johnson's insurance company paid him $20 a week for 8 weeks. How had he protected himself?

2. If Mr. Johnson had died from the effects of this accident, his family would have received $2000. What would you call such protection against accident?

3. Name other classes of people who need such protection.

4. Name other kinds of protection which people you know are carrying.

5. A man who has a family ought not only to provide for them while he can work, but he should also secure them against want if death should take him. Name ways of doing this.

6. He should also protect the home and contents against fire and storm. How may he do this?

7. To secure protection of the types described above, the person or firm who wishes the protection must pay a certain sum of money to the firm who agrees to pay if there is a loss. The latter is called an **insurance company.** The person protected is the **insured.** The money paid for the protection is called the **premium.** The money paid in case of loss is the **risk.** The agreement between the insurance company and the insured is the **insurance policy.**

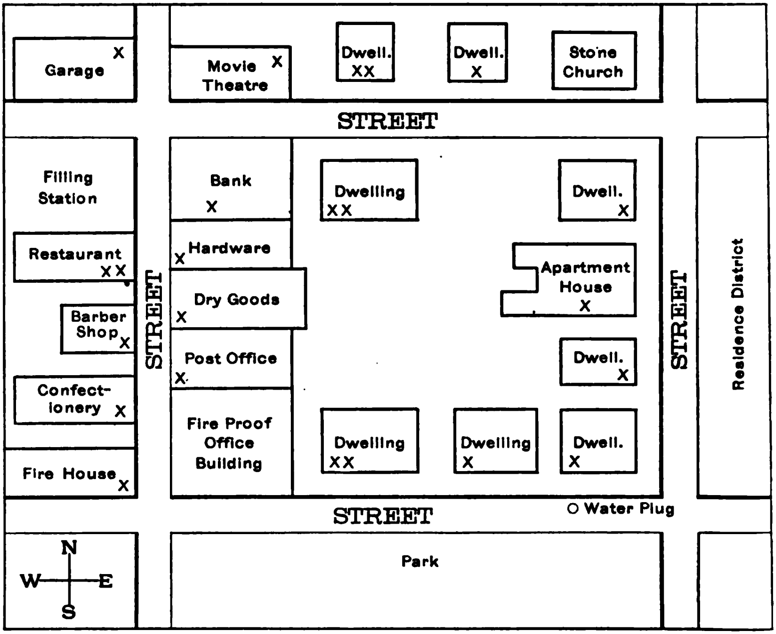
8. How can a company for a small yearly premium, say $10, afford to pay the owner $2000 in case his house is lost by fire? Some insurance companies have 50,000 policy holders.

9. If a house is worth $5000, insurance companies as a rule will not insure it for $5000. State several reasons why this is a good practice both for the insurance company and the insured.

10. My house is worth $4000. It is insured for $\frac{3}{4}$ of its value at a yearly rate of $5.00 per $1000. What is the premium?

11. In problem 10 find the rate of premium in cents per $100 of insurance valuation. Find it in per cent.

12. Mr. Ross owns a frame house worth $6000 in the country. Mr. Boyd owns a brick house worth $6000 in the residence portion of a large city with good fire protection. Which one must pay the larger yearly premium? Why?



A Plan of an Insurance District

X Shows Brick Bldgs. XX Frame Bldgs.

13. In the case of large cities, fire insurance companies have in their office plans showing the location and surroundings of property insured. In the plan on this page point out the buildings which may be insured at a low rate and those which must pay a high rate.

14. People usually insure their residence property for a period of 3 years or of 5 years. The rate for 3 years is about $2\frac{2}{3}$ times that of one year, and for 5 years it is 4 times that of one year.

15. When the annual rate is 42¢ per hundred dollars, what will it cost to insure a barn worth $1200 for a three-year period at 60% of its value? What would be the cost for a five-year period?

16. Why can a company afford to grant a cheaper rate for a five-year contract than for a one-year contract?

17. What expense do insurance companies have in securing business?

18. If a man should insure his furniture for $800 and later it was found that it could be replaced for $600, the insurance company may pay only $600 or they may replace the furniture in case of total loss by fire. Why is this a fair arrangement?

19. Careful housekeepers keep an inventory of their household goods. Of what use may it be in case of fire?

20. Where should the inventory and fire insurance policy be kept?

21. Mrs. Alfred Peter insured her furniture for $1000. After its total loss by fire the company offered to settle for $800. Her inventory showed that the furniture was worth $1500. Do you think she was required to settle for $800? What might the settlement have been if she could not have produced an inventory, nor shown in a satisfactory manner to the company that the furniture was worth $1000 at the time of the fire?

Life Insurance

1. Why ought people who are in good health have life insurance?

2. Ask some people whom you know to have life insurance (1) whether they think it is a good thing, (2) why they think so, (3) what kind they carry.

3. The more common contracts issued by life insurance companies are limited term policies, whole life policies, and endowment policies.

4. A limited term policy ceases at the expiration of the term for which it is written. The policy becomes payable only in case of death of the insured during the term. In this respect it resembles fire insurance.

5. In an ordinary life policy the insured pays a stated premium at regular periods for life, the policy becoming payable at the death of the insured. However, such a policy may be modified to permit the premiums to be paid in 10, 15, or 20 years. It is then called a 10-payment, or a 15-payment, or a 20-payment life policy.

6. The endowment policy becomes due at the end of a stated time, usually 20 years, at which time the insured is paid the full amount of his policy, unless death occurs sooner. In such case the policy is paid at death.

7. Most life insurance policies have a table of cash surrender values printed in the policy. Such value is the amount of cash the company will pay the holder if he wishes to surrender his policy at any stated period.

8. With the help of the table on the next page make and solve three good problems.

A Partial Table of Life Insurance Rates per $1000 of Policy

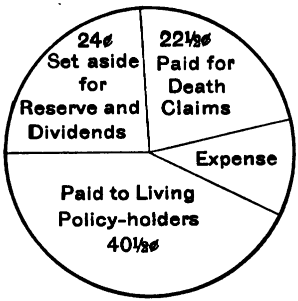
Age	5-Yr. Term	Ord. Life	20-Payment Life	20-Yr. Endowment
21	$11.60	$17.52	$25.54	$45.21
26	12.10	19.58	27.77	45.67
31	12.70	22.22	30.50	46.34
36	13.70	25.66	33.87	47.36
41	15.40	30.23	38.11	49.05

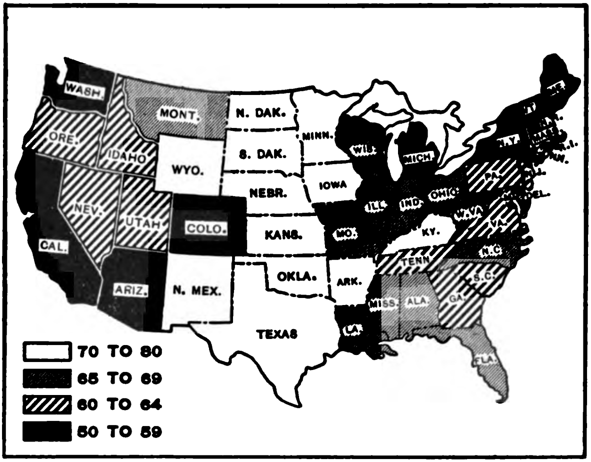
1. Which of the types mentioned in this table at a given age requires the highest premium per $1000? Which the lowest? Why?

2. Why does a 20-payment life policy require a larger premium than an ordinary life policy?

3. A young business man, age 26, with a wife and two children depending upon him for support, finds that he can spend only $100 a year for life insurance. If he wishes the maximum amount of protection for his family, what type of insurance should he purchase?

4. The graph shows what a certain life insurance company did in a recent year with each dollar of cash income. How much of the dollar was spent by the company for expense? To whom do dividends and reserve belong? The amount paid to living policy holders represents for the most part what kind of policy? What is the ratio of the total returned by the company to the expense?





PHYSICAL FITNESS GRAPH

Under the operation of the draft in the recent war, registrants were given physical examinations to find out who were fit for military service. Those who were sent to camp after passing the first examination were given another examination by the army surgeons. Some men were rejected on account of defects found after entering camp.

Problems About Health

1. From these two examinations facts have been found which show how the men from the different states compared in physical qualifications. The above map (distribution graph) shows four classes of states. What are they? White means that 70 to 80 out of each 100 examined were physically fit. What does black mean?

2. Name the states which showed the highest per cent of physical fitness. How many are there?

3. Name the states which showed the lowest per cent of physical fitness. These states divide themselves into two groups; those which attract many people suffering from certain diseases, and those which contain a large per cent of foreigners.

4. How do you account for the low record of Michigan? Of Washington? Of New York? The high record of Ky.?

5. The records show that every 100,000 country boys furnished for the military service 4790 more soldiers than each 100,000 city boys. Express this superiority in per cent. Why are country boys more likely to be physically fit than city boys? What can city boys do to improve their physical vigor?

6. A report of the causes of rejection of 10,258 recruits of the first selective draft in 1917 from eight different camps shows that 21.68% were rejected on account of defective eyes and 8.5% were rejected on account of defective teeth. Find the number rejected on account of these two defects. What can children do to avoid eye and tooth troubles?

7. In the first selective draft 2,510,706 men were examined; 730, 756 of this number were rejected on account of physical defects. Find the per cent rejected.

8. In the entire American army, both in France and in this country, there occurred 112,432 deaths from all causes. 48,909 were due to battle; 56,991 were due to disease; accidents and other causes contributed the rest. Find the % of deaths resulting from each of these three causes.

9. The influenza-pneumonia epidemic of 1918 killed more American soldiers than were slain in battle. This plague claimed in round numbers 48,000 victims. What % is that of the total deaths due to disease? See previous problem.

10. Compare the influenza deaths with those due to battle. Get your data from problems 8 and 9.

11. Typhoid was responsible for $\frac{1}{2}$% of the American army deaths due to disease, and tuberculosis accounted for 2.2%. How many soldier victims of each of these diseases? See problem 8.

12. The influenza-pneumonia epidemic of 1918 attacked 10,000,000 persons in the United States with a mortality of 400,000. Compute the cost of the epidemic on the following basis:

(1) Allow $25 for each case for medical care.

(2) Consider the average loss by death at $2400.

(3) Consider the average funeral cost at $90.

Do the above figures represent the total loss to society on account of influenza?

13. There are on an average 400,000 cases of typhoid in the United States each year. 10% of them are fatal.

(1) What is the annual death rate from this disease?

(2) What is the death rate per 100,000 on the basis of a population of 100,000,000?

(3) Compare the death rate in (2) with the death rate in the large cities in No. 14.

(4) Why is there less typhoid in the large city than in the small town and in the country?

14. The following table gives the typhoid death rate per 100,000 for each of the nine largest cities in the United States for the period from 1911 to 1918, except 1916.

City	1918	1917	Average 1911-'15
Chicago	1.4	1.7	8.2
Boston	2.5	2.9	8.0
Philadelphia	3.0	6.2	11.2
New York	3.7	4.0	8.0
Cleveland	4.7	7.1	10.0
St. Louis	7.2	7.5	12.1
Pittsburgh	9.8	11.2	15.9
Detroit	10.0	17.8	18.1
Baltimore	12.2	15.5	23.7

(1) Construct a line graph for 1917 and one for 1918 on the same sheet, showing the comparative death rates of these nine cities. Do your graphs intersect at any point? At which point are they farthest apart. What does this mean?

(2) Find for each city the % of death rate reduction for 1918 from the average of the 5-yr. period, 1911-1915.

(3) Which city shows the highest % of reduction? Which the lowest?

15. In a city of 180,000 there were on an average 450 cases of typhoid each year when unfiltered water was used. After filtered water was used, the cases were reduced to 85 a year. What was the per cent of decrease? In what other ways may typhoid be brought into a home?

16. Find out about how much it costs in your community to fight a case of typhoid if the patient recovers.

17. The following table shows the total deaths in 1917 and also the total deaths for each of six infectious diseases in the 12 principal cities of the United States. The estimated population is based on the rate of increase from 1910 to 1920.

Cities	Estimated Population	Total Deaths	Annual Rate per 1000	Measles	Scarlatina	Diphtheria and Croup	Whooping Cough	Typhoid	Consumption	Total Deaths Due to these Diseases
Baltimore	681,223	11,364	?	51	11	58	38	92	1213	?
Buffalo	481,857	7,559	?	8	30	108	55	48	699	?
Boston	724,817	12,722	?	102	46	278	44	22	1148	?
Chicago	2,546,778	38,055	?	245	624	1216	218	43	3284	?
Cleveland	725,984	10,848	?	53	14	155	129	53	1024	?
Cincinnati	389,950	6,833	?	24	15	51	36	16	856	?
Detroit	835,347	11,758	?	57	144	415	149	107	827	?
New York	5,364,870	78,575	?	556	120	1157	486	229	8824	?
Philadelphia	1,740,913	29,679	?	87	31	445	168	108	3019	?
Pittsburgh	571,906	10,657	?	60	11	131	48	66	677	?
San Francisco	480,960	7,154	?	36	12	68	28	23	744	?
St. Louis	747,136	11,626	?	98	62	205	39	58	1399	?
	?	?	?	?	?	?	?	?	?	?

(1) Find the value of each question mark in the above table.

(2) Compare the total deaths of the six common infectious diseases with the total of all the deaths in the 12 cities. What is an infectious disease?

(3) In 1917 in the above cities there were 13 deaths from smallpox. Find the death rate of smallpox per 1,000 for these 12 cities.

(4) Compare the death rate of measles with that of smallpox. Why do people fear smallpox so much more than measles?

(5) Compare the death rate of consumption with that of diphtheria. What can children do to avoid consumption?

(6) Compare the typhoid death rate with that of whooping cough. What can children do to avoid typhoid fever?

(7) Arrange the above cities in the order of their total death rate per 1,000.

18. Before the time of vaccination against smallpox 9 out of every 10 people over 30 years old were pock-marked and about one out of every 10 died of this disease. Find the death rate per 100,000.

19. In the ten-year period from 1901 to 1910 there were 380 deaths due to smallpox in Germany with a population of 50,000,000 in round numbers. For the same period in England and Wales with one-half the population of Germany there were 4286 deaths. Find the smallpox death rate per 100,000 in each country. Find the ratio of the two rates.

20. The conditions found in the previous problem are due to the fact that Germany has compulsory vaccination and England has not. Should the United States have compulsory vaccination for smallpox?

21. Malaria is a disease which is carried from one person to another by a certain kind of mosquito. A person cannot have malaria unless bitten by this mosquito. Ague, chills, and intermittent fever are other names for malaria.

22. If 80% of the malaria of this country (1,500,000 cases yearly) is preventable, how many unnecessary cases are there? How can children reduce this number?

Safety and Accident Prevention Problems

1. Three-fourths of all accidental deaths and injuries can be prevented. The United States in 1918 had 22,000 industrial accidental deaths and 500,000 serious injuries. How many unnecessary deaths and accidents occurred in our country in 1918 among industrial workers?

2. The following table is the record of fatal and serious accidents in industrial plants in the United States for two years. Find the value of each question mark.

	Deaths	Serious accidents (Time lost 4 wk. or more)	Serious accidents (Time lost 6 wk. or more)
1913	25,000	700,000	300,000
1916	22,000	500,000	260,000
% decrease	?	?	?

3. The following table shows the industrial loss in days in Wisconsin in 1915, 1916, 1917, due to accidents.

Days lost due to death,	3,110,000
" " " " permanent and partial disability,	1,897,700
" " " " absence from 1 to 2 weeks,	136,373
" " " " " over 2 weeks,	807,485

(1) What was the total loss in wages at an average of $4.00 per day?

(2) What was the average annual loss?

(3) The total loss above is equal to how many years if we count 300 work days equal to one year?

(4) Did the workmen lose anything in addition to their wages?

(5) Do you think many of these accidents were due to careless habits? When are careless habits formed?

4. The following table shows the accident record which is the result of an accident prevention campaign begun in a large steel plant in 1905.

Make a rectangle graph for the number of accidents per 1000 300-day workers and a line graph showing the relative time lost per 300-day worker from year to year.

Year	No. of 300-day workers	Accidents per 1000 300-day workers	No. of acci-dents	Days lost per 300-day worker	Total days lost	Loss in wages at $4 per day
1905	6406	300	?	34.5	?	?
1906	7494	214	?	54.3	?	?
1907	7585	189	?	38.1	?	?
1908	4575	150	?	29.9	?	?
1909	6215	174	?	23.7	?	?
1910	7642	134	?	19.9	?	?
1911	5774	112	?	18.6	?	?
1912	7396	153	?	14.3	?	?
1913	7652	115	?	21.3	?	?
1914	4741	74	?	12.2	?	?
1915	5599	48	?	20.6	?	?
1916	9634	96	?	13.4	?	?
1917	10862	85	?	12.9	?	?
Total			?		?	?

(1) Make a copy of this table and place in it the value of all the question marks.

HINT.—(1) No. of accidents in 1917 $= 10.862 \times 85 = 923$. Omit the decimal fraction part of the product. Why?

(2) Total days lost in 1917 $= 12.9$ days $\times 10862 = 140119.8$ days.

(2) In addition to the wages lost, what other loss did the worker hurt have to bear?

5. The following is the accident record of the Commonwealth Steel Company as the result of a safety campaign begun in 1913. Find the value of each question mark.

Year	Lost time cases	Employees	Days lost per employee	Total No. days lost	Av. No. days lost per case
1913	800	2511	7.2	?	?
1914	414	1964	4.2	?	?
1915	190	1112	2.3	?	?
1916	769	2121	2.6	?	?
1917	371	2538	2.4	?	?
1918	124	2473	.6	?	?
1919	38	912	4:0	?	?

HINT.—Av. no. days lost per case = total no. days lost ÷ no. of cases. Carry the quotient to one decimal place.

6. 235,000 of our soldiers out of an army of 2,200,000 in France were wounded during the period of 19 months in which the United States participated in the World War. During this same period there were 3,000,000 serious accidents in the United States. Find the ratio of safety between peace in the United States and war in France, estimating the population of the United States at 105,000,000. Explain your answer.

HINT.—Before making the comparison find the number of accidents per 1000 persons in each group.

7. During the war mentioned in the previous problem 70,000 in round numbers of our soldiers were killed or died from wounds or disease, while 120,000 persons met accidental deaths in the United States during the same period. Using the necessary data in problem 6, compare our war death rate in France with our accidental death rate at home.

8. Deaths from accidents in St. Louis from 1912 to 1919.

	1912	1913	1914	1915	1916	1917	1918	1919
Total number	492	530	459	402	525	510	420	370
Children killed under 10 years of age	80	88	70	70	78	75	86	73
Children killed from 10 to 20 years	59	40	45	34	42	48	28	34
Adults	?	?	?	?	?	?	?	?

(1) Find the value of each question mark by adding.

Thus, in 1912, 9 + 3 = 12. Write 3. Carry 1. 1 + 5 + 8 + 5 = 19. Write 5. Carry 1. 1 + 3 = 4. Write 3. The answer for 1912 is 353.

(2) What can school children in St. Louis do to reduce this number of deaths?

9. The main causes of fatal accidents in St. Louis.

	1912	1913	1914	1915	1916	1917	1918	1919
Automobiles	18	33	28	43	55	60	100	97
Burns	63	36	36	35	35	40	44	43
Falls	139	154	135	138	174	120	129	98
Steam R. R.	59	61	35	26	51	50	33	23
Street R. R.	43	54	35	28	27	32	27	27
All others	?	?	?	?	?	?	?	?
Total	492	530	459	402	525	510	420	370

(1) Find the value of each question mark by the method suggested in number 8.

(2) What is the % of increase of the 1917 total over the 1912 total? What is the % of decrease of the 1919 total compared with the 1912 total?

(3) Draw a line graph for the auto accidents from 1912 to 1919.

10. In the United States in 1917, 6000 children under 10 years of age were killed by accident, distributed among the causes shown in the table at the side.

Burns	2894
Drowning	884
Automobiles	380
Falls	783
Street cars	244
Railroads	217
Other vehicles	440
Other causes	?
Total	6000

(1) Find the value of the question mark.

(2) What % are the automobile accidents of the total number?

(3) Compare the street car accidents with the railroad accidents.

(4) What can children do to reduce the number of accidents listed under Burns, Drowning, Automobiles, and Street Railways?

(5) About how many more schools as large as yours would be needed if these deaths could have been avoided?

11. An auto moving at the rate of 15 mi. per hour is 60 ft. away from a person about to cross the street. Ought the person to take the chance if it requires 3 sec. to cross the street?

12. How far away must the auto in problem 11 be in order for a person to cross the street with safety ahead of the machine? Estimate this distance in the hall of your schoolroom or on the playground. Then measure it. How many % long or short is your estimate?

13. If each person killed on account of accident in the United States in 1919 were laid on a cot 6 ft. long and these cots were placed end to end, there would be a line of cots 60 mi. long. How many accidental deaths were there in the United States in 1919? How many of these deaths were unnecessary?

14. During safety week (Sept., 1918) there was one death due to accident in St. Louis. For the corresponding week in 1917, there were 24 deaths. What was the % of decrease? This decrease was due in a large measure to safety education.

15. In a certain large city the property damage as a result of 776 vehicle accidents for the month of October, 1919, amounted to $40,380. Compute to the nearest cent, (1) the average cost of each accident, (2) the average daily cost of these accidents.

16. 311 of the accidents mentioned in the previous problem were caused by motor vehicle colliding with motor vehicle. The property loss resulting from these 311 accidents was $24,037.50. Compute the average loss per accident to the nearest cent. Compare your result with the average cost per accident in the previous problem. What is the ratio of these two average costs to two decimal places?

17. Fatal accidents in four large American cities, 1918.

City	Est. pop. 1918	No. of accident deaths	No. deaths from auto accidents	No. accident deaths per 100,000	No. of auto accident deaths per 100,000
New York	5,450,000	4741	677	?	?
Cleveland	748,000	652	189	?	?
St. Louis	755,000	417	100	?	?
Rochester	279,000	65	9	?	?

(1) Find the value of each question mark.

(2) What % are the auto deaths per 100,000 of the total accident deaths per 100,000 in each city?

(3) Construct graphs representing in a striking way the conditions you found in the last two columns.

CHAPTER XI

COLLECTING AND DISTRIBUTING PUBLIC MONEY

Who owns the roads or streets in your neighborhood?

Who pays for their making and repair?

Who owns the schoolhouses in your county or city?

Who pays the teachers' salaries?

Who pays for the upkeep of public parks? Of public libraries? Of state universities?

Who pays the salaries of township, city, county, and state officers? Of letter carriers and postmasters?

The money with which a community, such as a village, city, township, county, state, or nation, pays its expenses may be obtained in any one or all of several ways.

I. A General Tax on Property

Certain property which a person owns in a given community may be taxed by that community a certain per cent (called the **rate of tax**) of the assessed value. The rate may be expressed as so many mills on the dollar, so many dollars on each $100, so much on each $1000, or such a per cent. The assessed value is the value placed against any property, real or personal, for taxing purposes. In some communities this is the full value, in others it may be as low as $33\frac{1}{3}\%$, or even less, of the full value. **Real property** is fixed property, such as land and buildings. **Personal property**, also called **chattels**, is movable, such as cattle, horses, money, notes, etc.

Methods of Expressing the Tax Rate and Solving Tax Problems

1. Tax rate = 22.5 mills (on each $1 of assessed valuation).

EXAMPLE.—Tax on $2000 = 2000 × 22.5 mills = $45.0000.

2. Tax rate = $2.25 (on each $100 of assessed valuation).

EXAMPLE.—Tax on $2000 = 20 × $2.25 = $45.

3. Tax rate = $22.50 (on each $1000 of assessed valuation).

EXAMPLE.—Tax on $2000 = 2 × $22.50 = $45.

4. Tax rate = $2\frac{1}{4}\%$ (of the assessed valuation).

EXAMPLE.—Tax on $2000 = $2\frac{1}{4}\%$ of $2000 = $45.

Tax Problems

1. In a certain large city each property owner must pay 2.25% of the assessed value of his property each year.

(1) How much is that on each dollar? On each hundred dollars? On each thousand dollars?

(2) In the above city Mr. Smith pays tax on an assessed valuation of $5100. Find his yearly tax.

2. In a certain large city the tax rate is $2.30 on each $100 valuation, distributed as follows: state purposes, $.13; public school purposes, $.63; municipal purposes, $1.54. Mr. A's assessed valuation is $4310. How much does he contribute to the state? How much to public schools? How much to the city? What is his total tax?

3. In a certain city the tax rate is 2.25% of the assessed valuation, which is 75% of the full value. A man pays $135 tax on a house and lot. Find the value of this property.

4. If the assessed valuation of the property in a city is $2,580,000 and a general property tax of $32,250 is to be raised, find the tax rate in mills on each dollar.

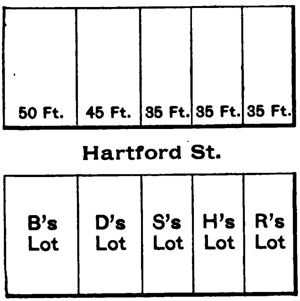
5. What is the general property tax rate in your community? How is it distributed?

6. Make and solve two problems based on the general property tax rate of your community.

II. Special Assessments on Property

If a community does a piece of work which is a special benefit to certain property in the community, the owners of such property must pay a special tax in addition to the general tax.

Examples.—Paved streets and cement walks in the city, macadam roads and drainage ditches in the country. Find others.



1. The total cost of paving that part of Hartford Street and making the walks, shown in the figure, was $4000. If the city paid half of the cost and the property owners facing the street paid half, compute the tax levied against Mr. B, against Mr. D, against Mr. S. The owners were given the option of paying the special tax in one sum or in several instalments with interest.

2. What % was Mr. R's assessment of that of Mr. B? Of that of Mr. D?

3. If the assessed value on this street is $50 a front foot and the general tax rate is 2.25%, find Mr. H's total general

and special tax if he elected to pay all his special tax in one sum. See previous page.

4. Mr. D paid his paving tax in 3 equal annual instalments, due in 1, 2, and 3 years with interest at 6% per annum payable annually. Compute his paving tax for each of these years. See previous page.

III. Licenses for Special Privileges

In most communities there is a dog tax of $1 per animal. In many communities a person must pay $5, or some other sum, yearly for the privilege of owning an automobile. In some, the owner of a lot in a city must pay a tax to have the street in front of his property sprinkled in dry weather. In others, druggists must pay $25, or some other sum, yearly for the privilege of conducting their business. Manufacturers of tobacco goods must pay the United States Government a certain sum yearly for the privilege of conducting their business. In some states persons must pay a certain sum (poll tax) for the privilege of voting.

1. Name other examples of special privileges which may be taxed.

2. If Mr. H named on page 104 is a druggist, owns one dog, an automobile, and lives in a city which has a sprinkling tax of 10¢ per front foot of lot, find his probable total tax for the year in which he paid his special street tax in full. See No. 3 on page 104 for Mr. H's general property and street paving taxes.

3. Find examples of special privilege taxes in your community.

IV. Payments Made for Direct Benefits Bought from the City

A community may sell water, heat, light, power, or railway transportation just as any private company may.

1. A certain large city in 1919 received 7¢ per 1000 gallons for 104.3 million gallons of water consumed daily. At this rate what was the city's income from its water plant in one year?

2. A manufacturing concern uses a monthly average of 29,600 kilowatt-hours of electricity bought from the city at a cost of 4¢ per kilowatt-hour. At this rate how much is paid by this concern to the city in one year?

3. A certain municipal street railway carries on an average 98,400 adult passengers each 24 hours. At the rate of 6 tickets for 25¢, what is the city's gross income from this source during the last 6 months of the year?

4. It is estimated that a city owned and operated gas plant can deliver artificial gas to the consumer at 80¢ per 1000 cu. ft. and still make a net profit of 4¢ per 1000 cu. ft. If there are 10,000 families in this city, who average 3000 cu. ft. of gas a month per family, what is the city's profit from this source in one year? What is the rate of profit?

5. A certain village received in one year $2080.50 from general taxes, $420.75 from special assessments, $1020 from licenses, and $1280 net profit from its light and power plant. What was the income from these sources? If this income was 75% of its total receipts, what were the total receipts? From what other sources might this village derive the remaining 25% of its receipts?

V. Tax on Incomes

Some states, certain cities, and our federal government* levy and collect an income tax. Such a tax is usually collected on the net income above a certain amount. At the present time (1921) our government collects an income tax on net annual incomes over $1000 in case of unmarried persons and on net annual incomes over $2000 in case of married persons. Persons with net incomes over $5000 must pay the regular rate, plus an additional rate. This rate varies with the size of the net income above $5000. This additional tax is called a surtax.

The following table shows a portion of the schedule of the amounts and rates of the graduated income tax for individuals in force Jan. 1, 1921.

Amount of net income	Rate of tax	
All of net income less $1000 or $2000	8%	
Except the first $4000 in excess of $1000 or $2000	4%	
$5000 to $6000	1%	additional
$6000 to $8000	2%	"
$8000 to $10000	3%	"
$10000 to $12000	4%	"
$12000 to $14000	5%	"

and so on, increasing 1% for each additional increase of $2000 net income to $100,000.

$100000 to $150000	52%	additional
$150000 to $200000	56%	"
$200000 to $300000	60%	"
$300000 to $500000	63%	"
$500000 to $1,000,000	64%	"
All in excess of $1,000,000	65%	"

* NOTE.—The sixteenth amendment to the Constitution of the United States, adopted in 1913, gave Congress the authority to levy a federal income tax.

How to Compute an Individual Income Tax

I. For a single person with a net income of \$7000.

Normal tax.

\$7000 − \$1000 exemption = \$6000, subject to normal tax.

$$\left.\begin{array}{ll}4\% \text{ of first } \$4000 & = \$160\\ 8\% \text{ of } \$2000 \text{ excess over } \$4000 & = \$160\end{array}\right\}\text{Normal tax.}$$

Surtax.

\$7000 − \$5000 exempt from surtax = \$2000 subject to surtax.

$$\left.\begin{array}{lll}\text{From } \$5000 \text{ to } \$6000: & \$1000 \text{ at } 1\% & = \$10\\ \text{From } \$6000 \text{ to } \$8000: & \$1000 \text{ at } 2\% & = \$20\end{array}\right\}\text{Surtax.}$$

\$320 normal tax + \$30 surtax = \$350 total income tax of a single person whose net income is \$7000.

II. For a head of a family with two dependent children with a net income of \$9000.

The head of a family is allowed \$2000 exemption plus \$200 for each dependent child under 18 years of age.

Normal tax.

\$9000 − (\$2000 + 2 × \$200) exemption = \$6600 subject to normal tax.

$$\left.\begin{array}{ll}4\% \text{ of first } \$4000 & = \$160\\ 8\% \text{ of } \$2600 \text{ excess over } \$4000 & = \ \ 208\end{array}\right\}\text{Normal tax}$$

Surtax.

\$9000 − \$5000 exempt from surtax = \$4000 subject to surtax.

$$\left.\begin{array}{lll}\text{From } \$5000 \text{ to } \ \ \$6000: & \$1000 \text{ at } 1\% & = \$10\\ \text{From } \$6000 \text{ to } \ \ \$8000: & \$2000 \text{ at } 2\% & = \$20\\ \text{From } \$8000 \text{ to } \$10{,}000: & \$1000 \text{ at } 3\% & = \$30\end{array}\right\}\text{Surtax.}$$

\$368 normal tax + \$60 surtax = \$428 total income tax of the head of a family with two dependent children whose net income is \$9000.

1. Find the income tax of a single person whose net income is \$8500.

2. What was the 1920 income tax of a married man whose net income amounted to $10200 if he has three dependent children?

3. Mr. Asa Graham and wife in 1920 had a combined net income of $21000. Find their income tax for that year.

4. Make and solve two other good income tax problems, based on the table on page 107.

VI. Tax on Imports

A large amount of money is raised yearly by our government by levying a tax on such imported articles as can be made cheaper abroad than in this country.

If gloves which cost $1.25 a pair to make in this country can be made in France at 90¢ a pair, then in order to permit the glove industry to exist in this country, Congress must levy a tax of 35¢ a pair on all imported gloves of the quality named. Why? What would happen if the tax were only 20¢ on each pair imported? What might happen if the tax were 60¢ on each pair imported?

A tax on imports is also called a duty or a tariff. Such duties are of two kinds, specific and ad valorem. A specific duty is a duty of so much per unit of the quantity imported, as oatmeal 30¢ per 100 lb., or butter $2\frac{1}{2}$¢ per lb., or beans 25¢ per bushel. An ad valorem duty is a certain per cent of the invoice price (importer's cost of the goods in the country bought), as horses 15%, cotton gloves 35%, silk clothing 50%.

The following table contains examples of specific and ad valorem duties taken from the Tariff Act of 1913.

Article	Schedule	Duty
Automobiles	C	Value over $2000, 45% ad valorem
		Value less than $2000, 30%
Oats	G	6¢ per bu. of 32 lb.
Barley	G	15¢ per bu. of 48 lb.
Oatmeal and rolled oats	G	30¢ per 100 lb.
Beans and lentils . . .	G	25¢ per bu. of 60 lb.
Peanuts	G	Shelled, $\frac{3}{4}$¢ per lb.
		Unshelled, $\frac{3}{8}$¢ per lb.
Cotton stockings . . .	I	Machine made, 20% ad valorem
		Wholly or partly handmade,
		value not over 70¢ per doz., 30%
		value not over $1.20 per doz., 40%
		value over $1.20 per doz., 50%
Gloves	I	Wholly or chiefly cotton, 35%
Handkerchiefs	I	Not hemmed, 25%; hemmed, 30%
Ready-made clothing .	K	Wholly or chiefly wool, 35%
Carpets	K	Axminster and moquette, 35%
		Wilton, 30%; Brussels, 25%
Silk clothing	L	50% ad valorem
Potatoes. . . .	Free List	No duty

NOTE.—In the tariff act similar articles are placed in the same schedule. The different schedules are named by the letters of the alphabet from A to N. Schedule I contains cotton manufactures and K contains woolen manufactures.

Problems

1. Tell which of the duties listed on this page are specific and which are ad valorem.

2. Why are hand-made stockings in Schedule I charged a higher rate than machine-made ones?

3. Why are high priced goods charged a higher rate than low priced goods?

4. Who is benefited by potatoes coming into our country duty free? Who is benefited by the 25% duty on Brussels carpets?

5. What % increase is the duty on shelled peanuts over that of unshelled peanuts? Who is benefited by this increase?

6. Which farmers are benefited by a duty on barley?

7. An Ohio farmer bought a team of Belgian horses for \$300, plus an ad valorem duty of 15%. How much duty did he pay?

8. A Chicago firm bought from a Canada farmer 150 bu. of barley; 1800 lb. of oats; and 60 sacks of beans averaging 65 lb. to the sack. Find the total duty on this invoice.

9. A St. Louis firm bought from a London firm goods as follows: 30 doz. not hemmed cotton handkerchiefs @ 30¢ per doz.; 2 doz. suits of boys' woolen clothing at \$4 each; 10 doz. machine-made cotton stockings at \$1.25 per doz.; and 40 yards of Brussels carpet at 40¢ per yard. Find the total duty.

10. Write and solve five other good problems based on the duties shown on the previous page. What are the requirements of a good problem?

CHAPTER XII

CONSTRUCTING AND MEASURING LINES AND ANGLES

Constructing Lines

1. On a sheet of unruled paper place any two points. With the help of ruler and pencil join these two points. What can you say about the line drawn? Note that only one straight line can be drawn through two points.

2. With a yardstick draw a four-foot line on your blackboard so that every point is six inches from the bottom of the board. Did you make any use of what you learned in number 1?

3. On an unruled sheet place a point. Using this point as a center, with the help of a compass or a piece of cord attached to the sharp end of a lead pencil, draw a line around the point. What can you say about this line (1) as compared with the line joining two points in problem 1? (2) as regards the point which you used as a center?

4. What do you call any part of the line you constructed in number 3?

5. With what units may you measure straight lines? What units are often used in measuring curved lines?

6. What is meant by a 90° arc?

7. Any portion of a given straight line is called a **segment** of that line. How can you find a 2-inch segment of a 3-inch line?

* NOTE.—Hereafter when the word line is used, a straight line is meant.

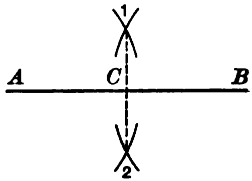
8. If a line is divided into two equal segments, it is said to be bisected (cut into two equal parts).

9. Three methods of bisecting a line.

(1) Find the mid-point by measuring with ruler.

(2) Fold the line on itself, making the two ends coincide.

(3) Using a radius greater than half of the line and the two ends as centers, construct intersecting arcs above and below the line. Then join the two points of intersection. The point at which the constructed line cuts the given line is called the mid-point of the line. Study the figure carefully. Later you will need this method in making other constructions.



10. Draw on unruled paper three equal lines of any length. Bisect them using each method shown in number 9.

11. Divide by method 3 a given line into four equal segments, or parts.

12. Using a radius, construct on a four-inch line a segment equal to the line *AB*.

13. If segment *AB* in number 12 is $\frac{2}{3}$ of a required line, construct that line with compasses or radius. Check your result by measuring with a ruler.

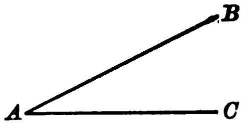
Constructing Angles

1. Place on an unruled sheet three points, *A*, *B*, and *C*.

2. Join *A* and *B*; *A* and *C*. Name the figure.

3. *A* is the vertex of the angle, and the two lines are the sides of the angle. Draw and letter two other angles.

4. An angle may be defined as the difference in direction of two lines which meet at a point.



5. An angle is read by naming the vertex, as angle A in the figure (the symbol for angle is $\angle$), or by naming a point on one side, then the vertex, then a point on the other side, as $\angle BAC$ in the figure.

6. When two lines intersect, they form four angles whose sum is 360°. Draw two intersecting lines. Letter and read the four angles. Which angles appear to be equal?

7. Draw two intersecting lines so that any one of the four angles is equal to any other one.

8. How many degrees in each of the angles in number 7? Do you know the name for all such angles?

9. The lines in the figure which you drew in number 7 are said to be perpendicular to each other because they form right angles.

10. Draw an angle less than a right angle. Name it.

11. When two lines begin at a common point and move in exactly opposite directions they are said to form a

straight angle. Thus, BAC is a straight angle whose vertex is at A. The direction of AB is toward the right. What is the direction of AC?

12. How does it affect the size of the angle in number 11 if the sides are prolonged? In general, is the size of an angle changed by making the sides longer?

13. Erect a perpendicular at the vertex of a straight angle. How many degrees in a straight angle? Why?

14. Draw an angle larger than a right angle and less than a straight angle. Can you name it?

15. Acute and obtuse angles are called oblique angles.

16. Without the help of the book, draw and letter the following angles: acute, obtuse, right, straight.

17. Find ten right angles in your room.

18. Can you draw an angle larger than a straight angle?

19. Where do we use oblique angles?

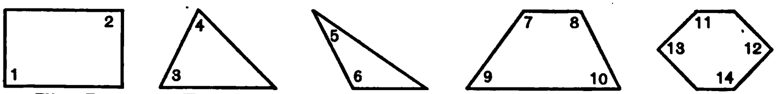


Fig. I Fig. II Fig. III Fig. IV Fig. V

20. From the angles named in the above figures select all the right angles, all the acute angles, all the oblique angles, all obtuse angles.

21. On squared paper draw a right angle and divide it into halves.

22. Draw an angle of about 60°. One of about 10°.

23. Figure VI shows 8 points of the compass. Name them. How many degrees in the angle made by the lines pointing north and east? North and northwest? Northwest and southwest? East and southeast?

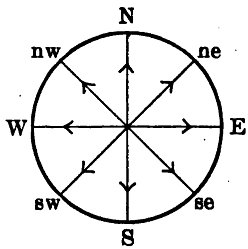
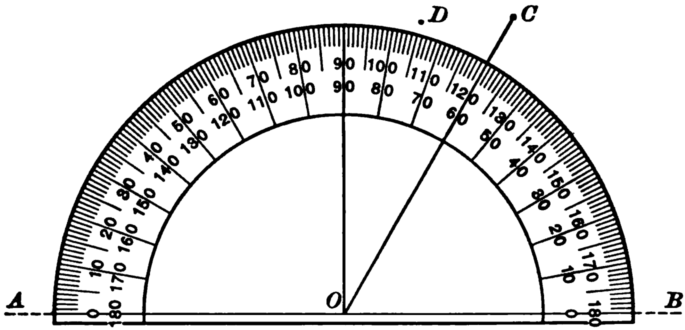


Fig. VI

1. If we wish to measure straight lines, what instruments may we use?

2. If we wish to measure or construct angles we commonly use an instrument called a **protractor.** See the figure. The curved edge of the protractor is divided into 180 equal parts, each of which is called a degree.



3. To measure an angle is to find how many degrees there are in the difference of the directions of the two sides.

How to Use a Protractor when it is Stationary

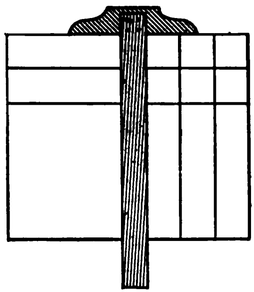
Trace the angle on thin paper. Place the vertex of the angle at the central point in the protractor, and one side of the angle on the upper straight edge of the protractor. The other side of the angle takes such a position that its size in degrees may be read from the arc of the protractor. Thus in the figure, $\angle BOC$ contains 60°, and $\angle AOC$ contains 120°. How can you measure an obtuse angle with the protractor in the figure? If D and O in the figure be joined with a line, find the size of angle made with OB; with OC; with OA.

How to Use the Protractor When It is Movable

Place the central point of the protractor on the vertex of the angle to be measured. Then place the upper straight edge of the protractor on one side of the angle. The other side of the angle will indicate on the protractor the size in degrees. Prolong this side if necessary.

Before measuring an angle, always estimate its size. Draw the following angles as accurately as you can, then measure them on the protractor to see how nearly you estimated correctly: 30°, 45°, 20°, 150°, 60°, 80°, 170°.

Parallel Lines and the T-square

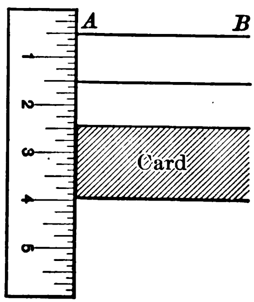


1. Two lines lying in the same flat surface that will not meet, however long they may be made, are called **parallel lines.**

2. The two opposite edges of this page are parallel lines. Find other examples of such lines.

3. The figure shows how a person may use a T-square in drawing parallel lines.

4. Construct a T-square out of heavy cardboard. Use it in drawing parallel lines.



5. Parallel lines may be drawn with a ruler or some other object with a straight edge, and a card with square corners and straight sides.

(1) Place the end of the card against the straight edge of the ruler as in the figure.

(2) Draw a line such as AB along the length of the card.

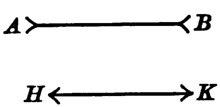
(3) Slide the card along the ruler any desired distance and draw a line as before.

(4) Why are the lines which you have constructed parallel to each other?

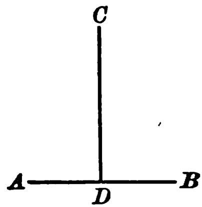
(5) Draw five parallel lines by the method suggested.

Problems about Lines and Angles

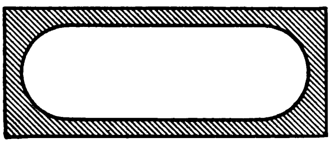
1. Estimate which is the longer line, AB or HK, and how much longer it is.



Then compare the lengths of the lines by means of compasses or marks on a straight edge of paper.



2. Estimate which is the longer, AB or CD, and how much longer. Then measure them.



3. This is a simple design for the trough of a pencil tray. Into what figures can you divide it? Find their dimensions and construct a similar design on a scale of 2.

4. A 40-inch wheel has a 4-inch hub. It also has 16 spokes.

(1) Draw a figure of this wheel using a convenient scale.

(2) How many degrees in the angle at the center of the wheel made by the center lines of any two adjacent spokes?

(3) How many degrees in the angle made by any two spokes in the same straight line?

CHAPTER XIII

Constructing and Measuring Surfaces

A flat surface bounded by straight lines is a **polygon.**

Draw a polygon with three sides, one with four sides, one with five sides.

Triangles

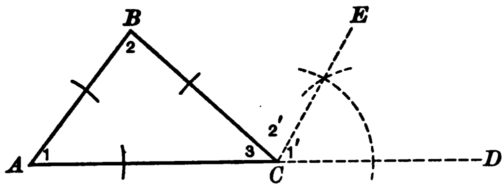
1. A triangle is a polygon with three sides.

2. The vertex of a triangle is the meeting point of any two sides. The base is the side on which the triangle rests. The altitude is the perpendicular from the vertex to the base or to the base prolonged. Read this paragraph again; then, closing the book, draw a triangle showing these parts.

3. Triangles named from their sides are called equilateral, isosceles, and scalene. Equilateral triangles have three equal sides. Isosceles triangles have two equal sides. Scalene triangles have no equal sides. Read this paragraph once more, and then, without the book, draw these triangles. Write the correct name under each figure.

4. See how many of these triangles you can find in your room, at home, or on your way to school.

5. Triangles named from their largest angle are called right, obtuse, or acute. Right triangles have one angle of 90°. Obtuse triangles have one angle larger than 90°. Acute triangles have no angle so large as 90°. Draw these triangles.



6. The sum of the angles of a triangle is 180°, or two right angles. Prove this by cutting ∠1 and ∠2, and placing them as shown in the figure. Also measure the three angles with the protractor and add the results.

7. Why can a triangle have only one obtuse angle? Only one right angle?

Problems about the Angles of Triangles

***A*, *B*, *C* are the angles of a triangle.**

1. $A = 90°$, $B = 40°$. Find C. What kind of triangle is it?

2. $B = 90°$, A and C are equal. What kind of triangle is this? Draw it.

3. $A = 100°$, $B = 40°$. Find C, and name the triangle.

4. $A = 60°$. Find B and C if they are equal. Name and draw the triangle.

5. $A = 40°$, $B = 60°$. Find C, and name the triangle.

6. Try to draw a triangle with two obtuse angles.

7. Try to draw a triangle with two right angles.

8. Draw and name a triangle with two acute angles.

9. Remember every triangle has two names. See if you can give two names to each of the triangles you have drawn.

10. Draw a triangle whose altitude falls on the base within the triangle, one whose altitude falls on the end of the base, one whose altitude falls without the triangle on the base prolonged. Name each of these triangles.

1. A polygon with four sides is called a **quadrilateral.**

2. There are three classes of quadrilaterals.

(1) Those with opposite sides parallel are called **parallelograms.**

(2) Those with one pair of parallel sides are called **trapezoids.**

(3) Those with no sides parallel are called **trapeziums.**

3. Draw and name each of the above figures.

4. Parallelograms whose angles are right angles are rectangles. Draw a rectangle.

5. Rectangles are either oblongs or squares.

6. A square is a rectangle with equal sides. Draw a square.

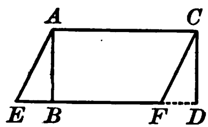
7. An oblong is a rectangle with opposite sides equal. Draw an oblong.

8. Parallelograms with oblique angles are called **rhomboids.** Draw a rhomboid.

9. A rhomboid with equal sides is a **rhombus.** Draw a rhombus.

10. Any side on which the parallelogram rests is the base.

11. The altitude is the perpendicular let fall from a vertex to the base or the base prolonged, as *AB*, or *CD*, in the figure, *AECF*.



12. A diagonal is the line drawn from one vertex to another one not adjacent.

13. Show base, altitude, and diagonal in the rhomboid you have drawn.

14. A trapezoid is a quadrilateral with one pair of parallel sides.

15. The parallel sides of a trapezoid are called its **bases.**

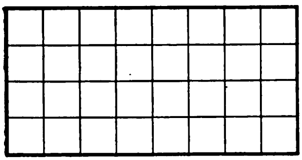
16. Can you draw a trapezoid with two right angles? Do it.

17. Can you draw a trapezoid with the two non-parallel sides equal? Do it.

18. A trapezium is a quadrilateral with no sides parallel. Draw a trapezium.

19. What are the three quadrilaterals? With books closed, draw them and write the correct name under each.

Measuring Rectangles



1. A rectangle 8 in. long and 1 in. wide contains how many square inches? See figure. A rectangle four times as wide and the same length contains $4\times$— square inches? See figure. Hence we may say: Area $= 4\times8$ sq. in. $=32$ sq. in.

2. Draw a rectangle 9 ft. by 15 ft. to a convenient scale and find its area.

3. A rectangular piece of land is 40 rd. long and 20 rd. wide. How many acres in it?

Hint.—A strip 40 rd. long and 1 rd. wide contains $\frac{1}{4}$ acre. How many such strips are there?

4. A square checkerboard measures 12 in. on the inside of the border. The squares are $1\frac{1}{2}$ in. long. How many squares in it? Draw the board to scale.

5. How many acres in a street 1 mi. long and 4 rd. wide? (Can you do this one without pencil?)

6. An oblong thrift garden measures 200 ft. by 150 ft. What part of an acre is it? Make an estimate. Then solve, expressing your answer in a decimal of three places.

7. Cut a $\frac{1}{4}$ in. square out of one corner of a square inch. What part remains?

8. How many acres in a square field whose perimeter is 1 mi.?

Always study your problem to see if it cannot be solved without pencil before trying written work.

9. Find the cost of the blackboard in your schoolroom at 10 cents per square foot.

10. How many square feet of lighting surface in your schoolroom?

11. How much floor space per pupil in your schoolroom?

12. Estimate by stepping, after measuring the length of your average step, the dimensions of your school ground.

13. Determine how many acres, or what part of an acre, it contains. Carry your answer to 3 decimal places.

14. If your school has a garden, make a map of it, drawn to scale. Find what part of an acre it contains.

15. Find the value of the land in this garden, if it is worth 40 cents per square foot.

16. Is the price per square foot in problem 15 a reasonable one for your locality? If not, find such a price.

17. A rectangle twice as long as wide contains 128 sq. in. What is the least number of squares into which it can be cut? What is the area of each of these squares? The length of each? What are the dimensions of the rectangle? Draw the figure.

Measuring Triangles

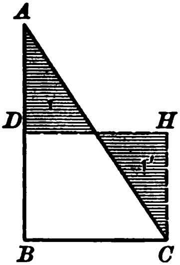


Fig. I

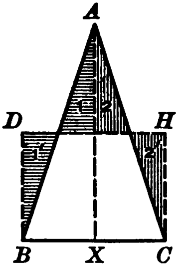


Fig. II

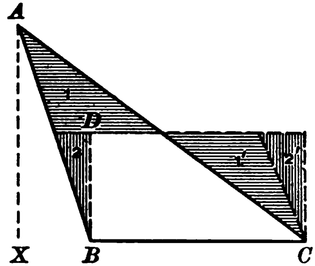


Fig. III

1. Study each of the figures above and discover that the area of the triangle in each case is equal to that of the rectangle whose length is the base of the triangle, and whose width is one-half the altitude of the triangle.

2. Prove the statement above by constructing three triangles, cutting them as indicated in the figures and fitting the parts as shown to make the equivalent rectangles.

Find the area of each of the triangles whose dimensions are given below, making your solution show that the area of a triangle is equal to that of a rectangle whose width is one-half the altitude of the triangle and whose length is the base of the triangle.

Thus in the triangle whose base is 12 ft. and whose altitude is 8 ft., the area is 12 sq. ft. $\times \frac{8}{2}$. Draw the figure to show this.

1. Base is 18 inches, altitude is 6 in.

2. Base is 3 yards, altitude is 2 yd.

3. Base is 10 feet, altitude is 4 ft.

4. Base is 6 ft., one side is 4 ft. The angle made by the base and this side is 90 degrees. Draw the triangle and find its area.

Measuring the Rhomboid

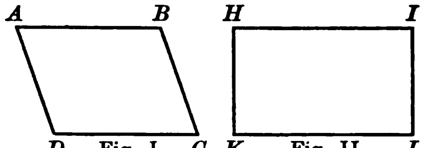


Fig. I Fig. II

1. Name figures I and II.

2. How are they alike?

3. How are they different?

4. Study figure I and discover how you may convert it into a rectangle with the same base and altitude as that of the rhomboid. Put your discovery in the form of a statement.

5. Show the truth of the statement in problem 4 by constructing a rhomboid and converting it into an equivalent rectangle by cutting and fitting.

Measuring the Rhombus

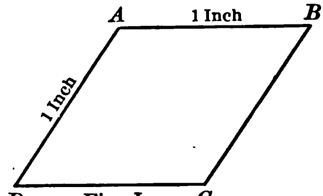


Fig. I

1. Write four names for figure I.

2. How do you find its area?

3. If the sides and altitude were equal, what kind of figure would it be?

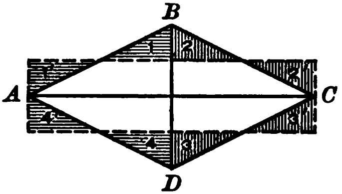
4. If the sides were equal and the altitude were zero, what would the figure be?

5. If the perimeter is 4 in., what is the largest rhombus you can draw? The smallest?

6. If the perimeter of various shapes of the rhombus is constant (always the same), but the altitude changes, what change is made in the area?

7. Between what two figures must all rhombuses lie?

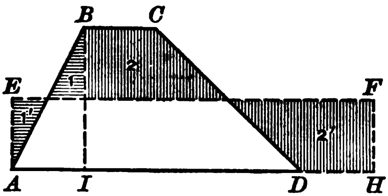
8. Draw a rhombus and its two diagonals. These diagonals bisect each other at right angles. What does this mean?



9. Study this figure and then show, by drawing and cutting, that your rhombus is equal to a rectangle whose length is one diagonal of your rhombus and whose width is one-half of the other diagonal of your rhombus.

10. From number 9 make a rule for the area of the rhombus when you know its diagonals.

Measuring the Trapezoid



1. A trapezoid is a quadrilateral with one pair of parallel sides, called upper and lower bases. Draw a trapezoid showing the two bases.

2. The altitude of a trapezoid is the perpendicular distance between the two bases. Draw a trapezoid showing the altitude.

3. An isosceles trapezoid has two equal non-parallel sides. Draw an isosceles trapezoid.

4. From the figure discover that the area of the trapezoid *ABCD* is equal to the area of the rectangle *EFHA*, whose width is one-half the altitude of the trapezoid and whose length is the sum of the two bases of the trapezoid.

5. A right trapezoid has two right angles. Draw a right trapezoid. Could a trapezoid have only one right angle?

6. Show by cutting squared paper and fitting that you can convert any trapezoid into a rectangle whose width is half the altitude of the trapezoid and whose length is the sum of the two bases of the trapezoid.

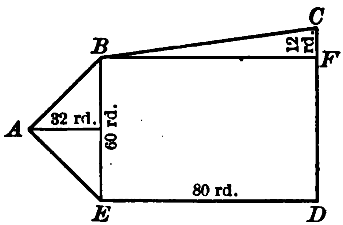
Study these problems and their figures to find the shortest way to solve them.

1. A trapezoid has parallel sides of 120 in. and 84 in., and an altitude of 40 in. Find its area in square feet.

2. The two parallel sides of a field having the form of a trapezoid are 120 rd. and 80 rd. The width is 40 rd. Find the area in acres.

HINT.—A strip 20 rd. long and 1 rd. wide contains $\frac{1}{8}$ acre. How many such strips are there?

3. This is a field drawn to scale with none of its sides equal and parallel. It is divided into the rectangle *EBFD*, the triangle *EAB*, and the triangle *BCF*. Find the area of the field in acres.

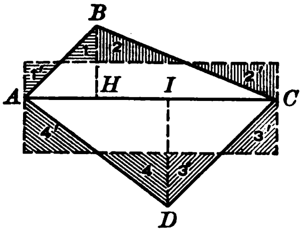


4. Draw a figure similar to the above in which *CD* is 180 rd., *EB* 160 rd., *ED* 240 rd., and the altitude of the triangle *EAB*, 40 rd. Find the area in acres.

5. If in the figure above a line is drawn from *E* to *F*, how many acres are there in the triangle *EFD*?

6. If a triangle is added on the side *CD* with a base equal to *CD* and an altitude of 40 rd., what is its area?

Measuring the Trapezium



1. Figure $ABCD$ is a trapezium whose diagonal is AC and whose altitudes drawn from the other vertices to this diagonal are DI and BH.

2. Study the figure and observe, (1) that the diagonal divides the trapezium into two triangles with a common base AC,

(2) that each of these triangles is divided into two right triangles by the altitudes drawn from the vertices D and B.

3. Discover that the trapezium is equal to a rectangle whose length is the diagonal of the trapezium and whose width is one-half the sum of the two altitudes.

4. Make a rule for finding the area of a trapezium.

The Circle

1. A circle is a flat surface every point of whose perimeter or boundary line is equi-distant from the center.

2. The bounding line is called the **circumference.**

3. The line passing through the center terminated by the circumference is called the **diameter.**

4. The **radius** is the distance from the center to any point in the circumference.

5. Any straight line drawn through a circle, terminating in the circumference, is called **a chord.**

6. Any part of the circumference is called an **arc** of the circle.

7. Draw a circle showing center, radius, diameter, circumference, a large arc, a small arc, a short chord, a long chord.

8. A portion of a circle bounded by two radii and an arc is a sector. When the radii make a diameter, the sector becomes a **semicircle.** When the radii stand at right angles to each other, the sector is called a **quadrant.**

9. Draw a circle showing a semicircle, a quadrant, a sector smaller than a quadrant, a sector larger than a semicircle.

10. For purposes of measuring, every circumference, however large or small, is divided into 360 equal parts called degrees. Arcs are measured in degrees. Thus the arc of a quadrant contains 90°, and the arc of a semicircle contains 180°.

11. Draw a sector whose arc is 45°, one whose arc is about 30°.

The Ratio of the Circumference to the Diameter

1. Measure as accurately as you can the circumference and diameter of three different circles at home. Compute the ratio of the circumference to the diameter to 4 decimal places in each case. Find the average of the 3 ratios. Place the work in the form here shown.

Object	Circumference	Diameter	$\pi = C \div D$
1. Bottom of bottle	4.5625	1.4375	3.1739 +
2.			
3.			
		Average	?

2. Place the average found by each of several members

NOTE.—Measure to 8ths or 16ths of an inch, or to millimeters if metric rulers are available. Express your results in decimals.

of the class on the board and determine the average for this group. If the work is carefully done, this result will closely approximate the ratio used in ordinary calculations, which is $3\frac{1}{7}$ or $\frac{22}{7}$ for oral work, and 3.1416 for written work. This ratio is represented by the Greek letter π (read pi).

3. C, D, and R stand for circumference, diameter, and radius. Read the following: (1) $D=2R$, (2) $C=\pi D$, (3) $C=2\pi R$, (4) $R=\frac{D}{2}$, (5) $D=\frac{C}{\pi}$, (6) $R=\frac{C}{2\pi}$.

4. Tell how to use each of the equations above.

Area of the Circle

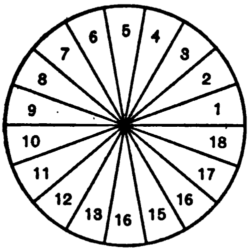


Fig. I

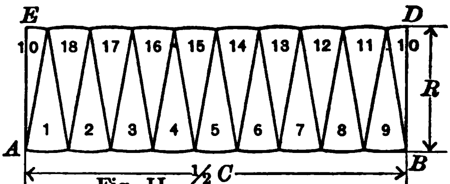


Fig. II

1. By drawing sectors as shown in figure I and cutting and placing them as shown in figure II, it will be seen that the circle is converted into a figure resembling a rectangle whose length is $\frac{1}{2}$ C and whose width is R. Then the area of the circle, which is approximately the area of the rectangle, is $\frac{1}{2}$ $C \times R$. This rule may be expressed as follows: the area of the circle $=\frac{C \times R}{2}$. This is the basic rule from which other rules may be made.

2. For the sake of economy it is better to express the rule in terms of one element of the circle, as R or D.

(1) $C=2R\pi$. Substituting this value for C in the basic rule, $\frac{C\times R}{2}$, you have, Area of the circle $=\frac{\cancel{2}R\pi\times R}{\cancel{2}}=\pi R^2$. (Read πR square.)

(2) $C=\pi D$. $R=\frac{D}{2}$. Substituting these values in the basic rule, you have, Area of the circle $=\pi D\times\frac{D}{2}\div 2=\frac{\pi D^2}{4}$.

3. Three rules for the area of the circle may be written as follows:

(1) Area $=\frac{C\times R}{2}\times$the unit of measure.

(2) Area $=\pi R^2\times$the unit of measure.

(3) Area $=\frac{\pi D^2}{4}\times$the unit of measure.

4. All numbers used in a formula are abstract. The formula for the area of the circle is used thus.

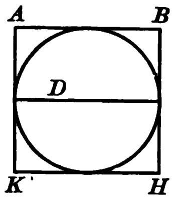
Problem.—Find the area of a circle whose radius is 5 ft.
Solution.—Area $=\pi 5\times 5\times 1$ sq. ft. $=25\pi$ sq. ft.

5. Find the area of each of the following circles. (1) $R=10$ ft. (2) $D=6$ in. (3) $C=20$ ft. (4) $D=2$ rd. (5) $R=3$ yd. (6) $C=14$ in. (7) $D=16$ ft. (8) $D=8$ in. (9) $R=1$ rd. In most cases it is best to express the answer in terms of π, as in (1) area $=100\pi$ sq. ft.

6. Measure the diameter of the base of three circular objects in the schoolroom or your home, and compute the area of each.

The Meaning of $\pi D^2 \div 4$ in Terms of the Square

1. In the figure, D, the diameter of the circle, is equal to the side of the circumscribed square, $ABHK$.



2. The area of this square is D^2.

The area of the circle is $\frac{\pi D^2}{4}$. (See Rule 3.)

3. Then the ratio of the circle to the square $ABKH$ is $\frac{\pi D^2}{4} \div D^2 = \frac{\pi \cancel{D^2}}{4} \times \frac{1}{\cancel{D^2}} = \frac{\pi}{4} = .7854.$

That is, the area of any circle is .7854 (a little more than $\frac{3}{4}$) of the area of its circumscribed square. This work shows that squaring the diameter is finding the numerical area of the circumscribed square.

The Meaning of πR^2 in Terms of the Square

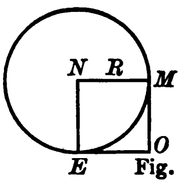


Fig. I

1. In figure I, the square $NMOE$ is erected on the radius R of the circle.

2. The area of this square is R^2.
The area of the circle is πR^2.

3. The ratio of the circle to the square $NMOE$ is $\pi R^2 \div R^2 = \pi$. That is, the area of any circle is π times the area of the square erected on the radius of the circle.

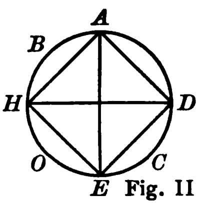


Fig. II

4. In figure II, why is the inscribed figure a square? How large is each angle at the center? Why? How many degrees in the arc ABH? Why?

5. Find the ratio of the circle BOC to the square $ADEH$. See figure II.

Before solving the problem, draw the figure for it.

1. What is the area of the largest square which can be cut from a circular piece of tin 12 inches in diameter?

2. Find the area of the quadrant of a circle whose radius is 8 feet.

3. Find the area of one of the four equal parts left by cutting the largest square possible from a circle whose radius is 6 ft.

4. Find the area of a path 3 ft. wide around a circular flower bed whose diameter is 15 ft.

5. What will it cost to cement the bottom of a circular basin 25 ft. in diameter, at $4.00 per sq. yd.?

6. How far is it around a 2-foot tree 3 feet above the ground?

7. What is the area of the largest circle which can be cut from a square card whose side is 6 in.? How much is waste?

8. The inner circumference of a circular running track is 1320 ft. Find the diameter of the enclosed circle.

9. A circular basin 16 ft. in diameter has a path 3 ft. wide around it. Find the length of the outer edge of the path.

10. How many revolutions will a 36-inch automobile wheel make in going 2 miles?

11. A tinsmith wishes to cut with the least waste a circular piece for the bottom of a pail 8 inches in diameter. What is the shape and area of the sheet from which he ought to cut the piece? Find the area of the waste? What % is the waste of the surface used?

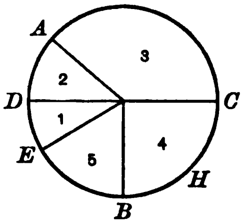


Fig. I

1. A sector is a portion of a circle bounded by two radii and an arc.

2. Read four sectors in figure I.

3. Which two are nearly equal?

4. What is the sum of the five sectors?

5. What part of the circle is sector 4?

6. What is the name for a sector of this size?

7. If the radius of the circle in figure I is 1 ft., what is the area of sector 4?

8. Can you find the length of *BHC* if the radius is 1 ft.?

9. Study figures II and III. If figure III is made from figure II by cutting and fitting as indicated, make a rule for finding the area of a sector, when the length of the arc and the radius are known in linear units, such as feet or inches.

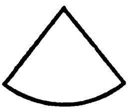


Fig. II

Fig. III

10. Compare your statement with the first rule developed for finding the area of the circle.

11. The radius of a sector is 8 ft. Its arc is 14 ft. Find the area.

12. Do you know something of the probable shape of the sector in problem 11?

13. If a classmate should say to you he can draw a sector with a radius of 7 ft. and with an arc of 22 ft., what would you say?

14. What is the largest possible sector you can draw with a radius of 8 in.?

Areas of Sectors: Given the Radius and the Arc in Degrees or the Size of the Central Angle

1. The length of an arc is sometimes measured in degrees. How many degrees in the circumference of a circle?

2. If you know the R of a circle, can you find the area?

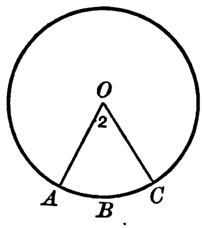
3. If you know the R of a sector, can you find the area? Why? How?

4. If the arc of a sector with a radius of 2 ft. is 36°, how many such sectors can you place in a circle whose radius is 2 ft.?

5. How do you find the area of the sector in problem 4?

6. The arc of a sector with a radius of 6 ft. is 30°. Find the area. Draw the figure to help you.

7. From the above work some pupils have made a rule for finding the area of a sector when they know its radius in linear units and its arc in degrees. Can you do the same? Try it. Write the rule and show it to the class tomorrow.



8. Angle 2 of sector AOC is called a central angle. It is said to measure the length of its arc in degrees. Thus, if angle 2 is 60°, then the arc ABC is 60°.

9. How many such angles can be drawn about the center O?

10. How many arcs, such as ABC, can be cut out of the circumference?

11. If you know the central angle of a sector and its radius, can you find the area of the sector? How?

1. Figure II was obtained from figure I by covering the convex surface (curved surface) of the cone with paper and then placing the paper in a flat position.

2. What relation is there between the sector (figure II) and the convex surface of the cone?

3. The slant height of the cone is the same as the ______ of the sector.

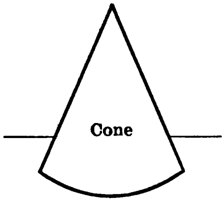


Fig. I

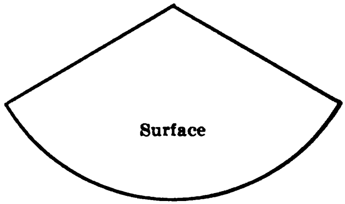


Fig. II

4. The circumference of the cone is the same as the ______ of the sector.

5. Knowing the arc and radius of a sector, how do you find the area?

6. Then how do you find the convex surface of a cone?

7. The slant height of a cone is 10 ft., its circumference is 20 ft. Find the convex surface.

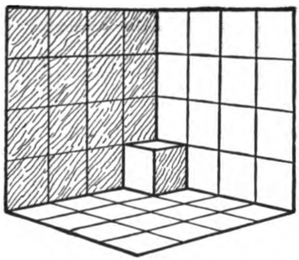
8. Make a paper funnel and find its area in square inches.

CHAPTER XIV

COMPUTING THE CONTENTS AND SURFACES OF SOLIDS

Rectangular Prisms

1. A rectangular prism is a solid which has length, breadth, and thickness, and six rectangular faces. What is a rectangle? Point out objects in your schoolroom representing rectangular solids.



2. The figure on this page represents a box 4 in. long, 4 in. wide, and 4 in. high, of which the front sides and top have been removed. How many cubic inches in its volume or contents?

The volume of a rectangular solid is the volume of its base, one unit high, multiplied by the number of such units in the thickness.

3. Find the volume of a rectangular prism, 6 feet long, 4 feet wide, and 3 feet thick.

The volume = 24 cu. ft. (Why?) × 3 (Why?) = 72 cu. ft.

4. How many cubic inches are there in a block 8 in. × 5 in. × 4 in.?

5. A solid is 8 inches × 4 inches × 2 inches. Find its volume. Do you know any such solids?

6. How many faces are there in the solid in problem 5? The bottom and top faces are called the upper base and the

lower base. Find the area of these bases. The other faces (how many?) are called lateral faces. Find the surface (called lateral surface) of these faces.

The Entire Surface of a Solid Equals the Surface of the Bases Plus the Lateral Surface

7. Find the entire surface of the solid in problem 5.

8. How many cubic feet of air space in your schoolroom?

9. How many cubic feet of air space per pupil in problem 8?

10. A bin is 14 ft.×12 ft.×6 ft. At $2.00 per bushel find the value of the wheat in this bin when one-half full.

11. How many tons of anthracite coal are there in a bin, when full, if there are $34\frac{1}{2}$ cubic feet in a ton? How many bushels in the bin? (A bushel of coal weighs 80 lb.)

12. Ask your janitor to give you the approximate dimensions in feet of your school coal bin. Then find how many tons of soft coal it will hold when $\frac{3}{4}$ full.

13. If the rainfall for a month is 3 inches, how much water falls on a boy's thrift garden, 100 feet by 40 feet?

14. In Columbus, O., the snow is sometimes 6 inches deep on the level. How many cubic feet does a boy shovel if he clears a walk 100 feet long and 4 feet wide?

15. The inside dimensions of a certain Pennsylvania steel freight car are 40 ft. 1 in.×8 ft. 10 in. wide×9 ft. 1 in. high. Find the capacity to the nearest cubic foot.

16. How many bushels of wheat may be placed in the car in problem 15 if it is filled to a depth of 5 feet?

17. Find and solve other problems, not in books, involving volumes and surfaces of rectangular solids.

Finding the Volume of Cylinders

1. A **cylinder** is a solid with equal parallel circles for bases and with a uniform diameter.

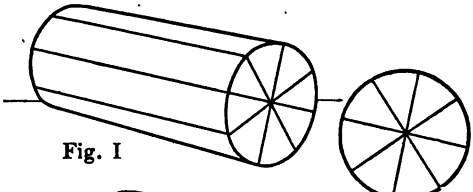


Fig. I

Base

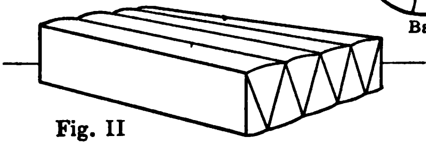


Fig. II

2. Name 5 objects which may be considered cylinders for all practical purposes.

3. How are figures I and II alike? How are they different? Name each figure.

4. Figure II is made from figure I. The dimensions of the base of figure II are the radius and one-half the circumference of the base of figure I.

5. How do you find the volume of figure II?

6. If the radius of figure I is 2 inches and its length is 12 inches, what is the volume of figure II? What is the volume of figure I?

The volume of a cylinder is equal to the volume of the base one unit high multiplied by the number of such units in the height.

7. Find the volume of a cylindrical tomato can whose radius is 2 inches and whose height is $4\frac{1}{2}$ inches.

Volume $= (\pi \times 2 \times 2 \text{ cu. in.}) \times 4\frac{1}{2}$

" $= 4\pi \text{ cu. in.} \times 9/2 = 18\pi \text{ cu. in.}$

Explain the above work. Estimate the value of $18\,\pi$ by giving π a value of $3\frac{1}{7}$.

8. How many cubic inches of water in a cylindrical tumbler 3 in. across the top and $3\frac{1}{2}$ in. deep, if it is full?

9. A cylindrical sugar box is 8 inches across and 5 inches deep. Find its capacity.

10. A certain size of Karo syrup cans is $5\frac{1}{2}$ in. deep by $4\frac{1}{2}$ in. in diameter. How much does the can lack of holding one-half gallon?

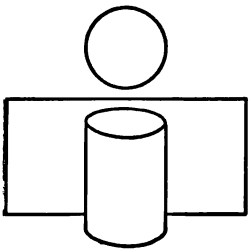
11. A cylindrical fish bowl is 15 in. across the top and 18 in. deep. How many gallons of water in it when it is $\frac{2}{3}$ full?

12. Measure 5 cylindrical objects at home and compute the volume of each.

Finding the Surface of Cylinders

1. Why do we need to know how to find the surface of cylinders?

2. Make a problem in which you need to know how to find the surface of a cylinder in order to solve your problem.



3. The figure shows the shape and size of a sheet of paper required to cover the curved surface (also called convex surface) of a cylinder which is $\frac{5}{8}$ in. high and $\frac{7}{16}$ in. across the top. What are the dimensions of the paper?

4. What is the area of the paper?

5. How find the curved surface of a cylinder?

6. How find the entire surface of a cylinder?

7. A steam pipe is 30 feet long and 4 inches in diameter. What is its heating surface?

8. How much will it cost to paint a cylindrical smoke-stack 40 ft. high and 3 ft. in diameter at \$2.00 per 100 square feet?

9. How many square feet of sheet iron in a furnace pipe whose length is 15 feet and whose diameter is 9 inches, if $\frac{1}{2}$ inch is allowed for lap along the length?

Cylinder Problems

1. How many thousand cubic feet of gas in a cylindrical tank 24 feet in diameter and 30 feet high?

2. What is the value of the gas in problem 1 at 80¢ per 1000 cubic feet?

3. How much sheet iron, if $\frac{1}{2}$ inch is allowed for the lap, will be required to make four pieces of stove pipe each 30 inches long and 5 inches in diameter?

4. How much sheet iron in a cylindrical metal cask 4 feet high and 30 inches in diameter if a strip 1 inch wide is allowed along the height for lap?

5. Find the value at 25¢ a gallon of the gasoline in the above cask when it is $\frac{3}{4}$ full.

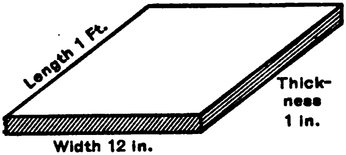
6. A man wishes to make a cylindrical half bushel measure with a diameter of 12 inches. How deep must it be?

7. A wagon for watering streets has a cylindrical tank 3 ft. in diameter and 8 ft. long. How many gallons will it hold? Count $7\frac{1}{2}$ gal. to the cu. ft.

8. How many gallons of water in a cylindrical cistern 10 feet deep and 4 feet in diameter? (Use $7\frac{1}{2}$ gallons to the cubic foot, also 231 cubic inches to the gallon. How much is the difference in the two answers?)

Measuring Lumber

Some lumber, such as boards, planks, etc., is measured in board feet. Other lumber, such as lath, plaster lath, and shingles, is measured either in linear feet or by the 100 pieces.



A board foot is a piece of lumber 1 foot long, 12 inches wide, and 1 inch or less thick. See figure.

Boards less than one inch thick are considered an inch thick in computing lumber.

Problems

1. If a board foot is 1 ft. long, 12 in. wide, and 1 in. thick, a board 16 ft. long, 12 in. wide, and 1 in. thick has how many board feet?

2. How many board feet are there in a board 16 ft. long, 9 in. wide, and 1 in. thick? How many if it were 2 in. thick? If it were $\frac{3}{4}$ inch thick? See the definition of a board foot on this page.

3. How much lumber is there in a plank 12 ft. long, 8 in. wide, and $2\frac{1}{2}$ in. thick?

SOLUTION.—1. Amount of lumber $= \cancel{12}$ bd. ft. $\times \frac{\overset{4}{\cancel{8}}}{\cancel{12}} \times \frac{5}{\cancel{2}}$.

2. Amount of lumber $= 20$ bd. ft.

4. How many board feet in a stick of timber 14 ft. long, 6 in. wide, and 4 in. thick?

5. How many board feet in your desk top?

6. Find the cost of 1200 board feet of white oak lumber at \$90 per M. (thousand).

CHAPTER XIII

REVIEWING THE YEAR'S WORK THROUGH PROBLEM SOLVING

1. In a January clearance sale a \$52 oak extension table sold for \$35. What was the per cent of reduction?

2. In a special sale woolen cloth, which regularly sold at \$1.50 a yard, brought only \$1 a yard. What was the % of discount?

3. When evening wraps are reduced from \$65.00 each to \$45.00, what is the % of reduction?

4. Find other discount problems in the advertising columns of your newspaper and solve them.

5. Goods bought at 20% and 10% off the list price are sold at the list price. Find the rate of gain on the cost.

6. I bought goods listed at \$400 at 10% and 5% off and sold them at 15% above list. What was my rate of gain on the selling price?

7. A merchant bought shoes at \$6 per pair. If his expenses are 20% of the cost, at what price must he sell them to clear $12\frac{1}{2}$% of the gross cost?

8. An article costing \$3.50 is so marked that after deducting 16% from the list price it is sold at a profit of 20% of the cost. Find the list price.

9. A merchant sells an article for \$150, gaining 20% on the cost. If he had bought it for $\frac{1}{5}$ less and sold it for \$30 more, what would have been the gain per cent on the cost? What on the selling price?

10. A coal dealer bought 200 long tons of coal at \$3.50 per ton and sold it at \$6.00 per short ton (1919 price). Determine his profit if it cost him \$1.00 per ton to deliver it.

11. When the rate of gain is 20% of the cost, what is the rate based on the selling price?

12. When the loss is 25% of the selling price, find the rate based on the cost.

13. The top price paid for hogs at the National Stock Yards in July, 1918, was \$16.60 per hundred weight. In July, 1919, the price was \$22.35 per hundred weight. Find the % of increase.

14. In July, 1919, W. A. Emmert of Mahaska Co., Ia., sold through the Moody Commission Company at the National Stock Yards, East St. Louis, Ill., 198 hogs averaging 224 lb. at \$22.10 per 100 lb. Find the commission at $1\frac{3}{4}$%.

15. The premium on an insurance policy was \$20. What was the face of the policy if the rate was $2\frac{1}{2}$%?

16. George Jones owns a house worth \$3000 insured at $\frac{3}{4}$ of its value at $1\frac{1}{2}$%, and household goods worth \$1000 insured at 60% of their value at 2%. Find the cost of his insurance.

17. Mr. B's personal property is assessed at \$2450, and his real estate at \$6500. Find his tax when the rate was \$2.35.

18. In a certain month Mr. Johns wrote six life insurance policies as follows: \$10,000, premium \$32.80 per thousand; \$10,000, premium \$35.60; \$25,000, premium \$41.20; \$15,000,

premium \$36.40; \$25,000, premium \$29.60; \$5,000, premium \$37.20. If he received 40% of the total premiums, what was his commission?

19. A man in Texas owns 160 acres of land worth \$100 per acre. His taxes are 12 mills on a $\frac{3}{4}$ valuation. His insurance is \$40 a year. In 1919 his tenants raised 1500 bushels of corn worth \$1.60 a bushel, 600 bushels of oats worth 75¢ a bushel, and 27 bales of cotton worth \$175 per bale, including the cotton seed. If the owner of the land received $\frac{1}{3}$ of the corn and oats and $\frac{1}{4}$ of the cotton, what % net did the land earn for him?

20. The following items show the cost of growing one acre of cotton on Texas land producing $\frac{1}{2}$ bale (250 lb.) of fiber cotton per acre: plowing and harrowing, \$3; planting, \$1.00; seed, 50¢; chopping (thinning), \$2.00; cultivating, 4 times, \$5.00; picking 750 lb. seed cotton @ 1¢ per lb.; ginning and bagging, \$3; interest at 6% on land worth \$75 per acre; tax at 2% on $\frac{1}{3}$ valuation. Find the total cost of growing one acre. In 1918 cotton was worth 30¢ a lb., and cotton seed sold at \$60 per ton. It takes 750 lb. of seed cotton to produce $\frac{1}{2}$ bale of fiber cotton. On this basis, what was the profit on one acre of 1918 cotton?

21. I bought a house for \$3600. I kept it three years. Each year I paid $2\frac{1}{2}$% for taxes on a $\frac{2}{3}$ valuation. The insurance for the three years was $1\frac{1}{2}$% of the cost of the house, and repairs cost \$140 for the three years. If I rented the house for \$25 per month, losing in the 3 years 2 months' rent, what was my net annual income? What % on my investment was this?

Solving Problems by Telling How

In this exercise think how you would solve the problem; then write in a sentence the answer to the question.

1. How do you find the net price, when the list price and the rate of discount are given?

2. How do you find the list price when you know the net price and the rate of discount?

3. How can you find the single rate of discount which is the equivalent of two successive rates of discounts?

4. How do you find the % of gain on the selling price when you know the cost and the gain?

5. Find the cost when the selling price and the % of gain on the cost are given.

6. Given the agent's cost price and the rate of commission, find the commission.

7. If you know the owner's remittance to his agent and the % of commission, how can you find the agent's cost price of the goods?

8. If you know the tax rate in dollars per thousand of assessed valuation and the assessed valuation of a piece of property, how do you find the tax?

9. Given the rate of insurance and the face of the policy, how do you find the premium?

10. If you know the number of men examined for military service and the number rejected, how can you find the % passed?

11. Given the population of a city in a certain year and the number of deaths for that year, how can you find the death rate per 1000?

12. If you know the death rate of one city per 1000 and of another per 100,000 how can you find the ratio of the death rates of the two cities?

13. How do you reduce a common fraction to the equivalent %?

14. If you know the amount an agent receives for goods, his rate of commission, the amount of storage, and other charges, how can you find the amount of the agent's remittance to the owner?

15. If you know the number of articles imported, the specific duty on each, the rate of ad valorem duty, and the amount of the invoice, how can you find the importer's cost?

16. If you know the population of your state in 1910 and also in 1920, how do you find the % of increase?

17. What must you know and what must you do to find the average school attendance of your class for a month?

18. What measurements would you take and what would you do to find how many gallons there are in a rectangular tank when it is $\frac{1}{2}$ full?

19. If you know the number of men employed by a firm and the number of hours per day each worked, what must you know and do to find the amount of the firm's pay roll for the week?

20. If you know the purchase price of a house and lot, the taxes per year, and the sum of the other yearly expenses, how would you find the rent that must be charged in order that the owner may make a given % of interest on the cost of his property?

Reviewing Surfaces and Solids

Write your answer in good English.

Remember that some of these questions may have more than one answer.

Construct the figure if it will help you to answer the question.

What can I find and how can I find it if I know:

1. The length of a cube?
2. The radius of a circle?
3. The side of a square?
4. The base of a right isosceles triangle?
5. The circumference of a circle?
6. The area of one face of a cube?
7. The diameter of the base and the altitude of a cylinder?
8. The base and altitude of a right triangle?
9. The base and altitude of a rectangle?
10. The radius of a sector and its central angle?
11. The dimensions of a rectangular solid?
12. The radius and length of a cylinder?
13. The two angles of a triangle?
14. One of the acute angles of a right triangle to be 45°?
15. The bases and altitude of a trapezoid?
16. The diagonal of a trapezium and the two altitudes drawn to it?
17. The dimensions of a rectangular coal bin?
18. The radius of a sector and its arc in feet or inches?
19. The diameter of a circle?
20. A circle and its circumscribed square?

If James sold 85 newspapers on Saturday, how much money did he receive for them?

You cannot solve this problem as it stands because it is incomplete. What else must you know in order to solve it?

ANSWER: You must know the amount James received for a paper.

SOLUTION: The amount of money he received = 85 × what he received for each paper.

Below you will find other incomplete problems. Write what else you must know in order to solve the problem. Then solve it.

1. A submarine made a voyage of 500 miles going part of the distance under water and part on the surface. Find the distance traveled on the surface.

2. A grocer received a bill for 1000 pounds of sugar. Find the cost of the sugar per pound.

3. I made a purchase of $2.50 at a store. Find the amount of change I received.

4. A newsboy sold 20 magazines. Find the profit he made on each magazine.

5. It requires 18 ounces of dough to make a loaf of bread. Find the weight of dough a baker must prepare to supply all his customers for a day.

6. If a load of brick carried by a hod carrier weighs 100 pounds, find the weight of a single brick.

7. A fruit dealer paid $7.50 for a crate of oranges. What price did he pay per orange?

8. A train runs from city A to city B in one hour. Find the distance from A to B.

9. Last year John grew $2\frac{1}{2}$ inches, and this year he has grown 3 inches. How tall is John?

An Exercise in Estimating Results

Often in life you can use your knowledge of arithmetic in checking your answer to a given question. This exercise illustrates this type of problem solving.

On a sheet of paper put in a column the numbers of these problems from 1 to 6, leaving a little room between the numbers for your work. The answer to these problems is either Yes or No. Read the problem carefully. When you have decided on the answer write it after the number of the problem on your paper. Then check your answer by solving the problem.

1. If oranges sell at the rate of 3 for 10¢, can you buy as many as 10 for 40¢?

The right answer is *Yes;* therefore write *Yes* opposite No. 1 on your paper. This is the way to check your answer. Check.—The number bought for $40c = \frac{40c}{10c} \times 3 = 12$.

2. I went to the store with a five dollar bill. If I purchased $3.50 worth of groceries, could I buy as much as 20 pounds of sugar at 10¢ a lb. with the change?

3. If a crate of oranges containing 9 dozen costs a fruit dealer six dollars, can he afford to sell the oranges for 5 cents apiece?

4. If a barrel of flour makes 243 loaves of bread, will a baker who makes 1,000 loaves of bread daily use 10 barrels of flour a day?

5. One water pipe can fill a tank in four hours, and another pipe can fill it in five hours. If both pipes are allowed to run, will they be able to fill the tank in two hours?

6. John is now twice as old as Henry. When Henry's age is double what it now is, will John's age then be twice Henry's?

This is the Rice Test given in 1902 to 974 7th grade children. The average achievement (right answers) for the best class was 81.1%; for the poorest class it was 18%; the average for all the classes was 39.4%.

Try to solve 6 right in 30 minutes.

1. If a map 10 inches wide and 16 inches long is made on a scale of 50 miles to the inch, what is the area in square miles that the map represents?

2. The salt water which was obtained from the bottom of a mine of rock salt contained 0.08 of its weight of pure salt. What weight of salt water was it necessary to evaporate in order to obtain 3896 pounds of salt?

3. A gentleman gave way $\frac{1}{7}$ of the books in his library, lent $\frac{1}{6}$ of the remainder, and sold $\frac{1}{5}$ of what was left. He then had 420 books remaining. How many had he at first?

4. A farmer's wife bought 2.75 yards of table linen at $0.87 a yard and 16 yards of flannel at $0.55 a yard. She paid in butter at $0.27 a pound. How many pounds of butter was she obliged to give?

5. If coffee, sold at 33 cents a pound, gives a profit of 10%, what per cent of profit would there be if it were sold at 36 cents a pound?

6. Steel was sold at $27.60 a ton, with a profit of 15%, and total profit of $184.50. What quantity was sold?

7. If a woman can weave 1 inch of rag carpet a yard wide in 4 minutes, how many hours will she be obliged to work in order to weave the carpet for a room 24 feet long and 24 feet wide? No deduction to be made for waste.

The Reavis Problem Test without Figuring

A 7th grade. pupil good in problem solving should write 7 correct answers in 20 minutes. After the test solve those you did not try, also those you missed.

1. A submarine made a voyage of a given number of miles, going a certain number of miles under water and the remainder of the distance on the surface. How would you find the distance traveled on the surface?

2. A grocer received a bill giving the number of pounds shipped and the cost of an order of sugar. If you were given this bill, how would you find the cost of the sugar per pound?

3. If you know the weight of dough required to make a single loaf of bread, how would you find the weight of the dough a baker must prepare to make a given number of similar loaves?

4. A fruit dealer bought a stalk of bananas containing a certain number of dozens for a certain price. How would you find the cost per dozen?

5. If you know the cost of my purchase at a store and the amount I had when I left the store, how would you find the amount of money I had when I went to the store?

6. If you know the number of brick carried by a hod carrier at a load and the weight of the load in pounds, how would you find the weight of a single brick?

7. A man bought a house and lot for a certain price. He paid a certain amount in cash and gave a mortgage for the rest. How would you find the amount of the mortgage?

8. If you know the number of hours required by a train to go from one city to another and the speed of the train per hour, how would you find the distance between the cities?

9. At a school picnic the patrons gave a treat of ice cream to each child present. If you knew the number of children a gallon of ice cream would serve and the number of children present, how would you find the number of gallons required to treat all the children?

PART II—EIGHTH YEAR

CHAPTER I

SHORT TESTS IN THE FUNDAMENTALS FOR SPEED AND ACCURACY*

Before finishing the 8th grade you should be able to do the number right indicated in each exercise in the time allotted if you are a standard pupil in that particular exercise. If you finish an exercise in less than the given time, you should spend the remainder in checking your work. It is more important to be accurate than to attempt more than the standard.

I

Addition—All right in one minute.

1.	2	3	9	4	6	8	4	6	4	3	2	9	7	7	2
	4	8	5	2	6	0	3	9	5	2	7	9	6	7	5
2.	4	8	4	7	3	8	2	5	6	7	9	9	3	9	7
	7	9	6	9	5	3	9	8	5	2	0	6	4	3	8
3.	9	5	2	4	8	4	5	6	9	4	5	5	8	3	7
	1	2	8	9	6	4	7	3	8	8	9	5	2	3	4

* NOTE.—In most cases the answers can be written on a slip of paper laid below the examples. Where examples need to be transferred, additional time should be allowed.

II

Subtraction—All right in one minute.

1.	1	4	5	6	3	2	7	3	4	5	4	9	7	6	9
	1	1	4	1	1	1	2	2	2	1	4	5	5	6	2
2.	5	7	6	7	6	6	3	5	8	7	4	7	9	8	8
	5	1	2	3	4	5	3	2	1	6	3	7	1	2	8
3.	2	8	9	8	9	9	8	6	9	8	9	9	5	8	7
	2	3	9	7	8	3	6	3	7	4	6	4	3	5	4

III

Subtraction—All right in two minutes.

1.	18	10	16	12	17	15	12	15	13	14	16	10	11	10	10
	9	9	9	9	8	8	7	6	5	8	7	7	6	4	1
2.	17	14	12	13	14	10	12	11	12	11	16	11	14	10	13
	9	9	8	7	6	6	5	4	3	9	8	7	5	2	4
3.	13	10	14	13	10	10	15	12	11	11	12	11	15	13	11
	9	8	7	6	5	3	7	6	3	2	4	8	9	8	5

IV

Multiplication—All right in one minute.

1.	3	4	9	0	5	4	3	2	7	4	9	6	5	4	7
	2	7	8	2	6	1	6	9	6	0	5	9	2	8	0
2.	6	2	9	0	7	9	2	7	0	8	9	3	9	2	4
	5	7	6	5	4	7	8	7	6	3	2	8	9	0	3
3.	4	8	0	4	6	8	0	9	3	6	3	6	7	5	4
	4	9	3	5	2	8	7	3	4	8	9	3	9	5	6

V

Division—All right in one minute.

1.	3)9	4)32	6)36	2)0	7)28	9)9	3)21	6)48	1)1
2.	5)10	4)24	7)63	6)0	8)32	1)8	5)30	8)72	1)0
3.	9)36	1)7	2)10	7)42	1)1	6)18	4)20	7)49	1)3
4.	2)8	6)6	3)27	8)64	1)2	5)0	3)24	9)63	8)24
5.	7)7	2)18	6)42	3)0	7)21	4)4	3)15	9)81	7)0

VI

Addition—5 right in one minute.

56	22	96	82	56	14	41	39
27	78	82	85	93	40	41	39
28	38	30	15	64	28	51	12
15	45	79	36	83	55	38	59
45	11	63	80	78	46	44	76

VII

Subtraction—10 right in one minute.

971	821	934	408	725	561	733
363	130	738	265	482	172	507
708	616	854	365	905	496	1001
578	259	286	178	286	327	842

VIII

Multiplication—All right in one minute.

2534	3075	7689	6879	3245	2354	3524
5	2	5	9	6	4	7

IX

Division—4 right in one minute.

$4\overline{)38968}$	$6\overline{)21279}$	$7\overline{)39872}$	$8\overline{)66720}$	$9\overline{)71289}$

X

Addition—6 right in 3 minutes.

8685	7521	2846	8253	7296	3580	4765
4944	2754	6389	7594	6802	6295	3698
5636	4856	3528	6031	3690	3782	8787
3678	7039	3893	7426	3285	9061	7669
3869	9483	4678	7426	9735	3648	8327

XI

Multiplication—5 right in 3 minutes.

43957	52468	73098	87692	30296	65382
73	46	29	37	31	48

XII

Long Division—3 right in 3 minutes.

$32\overline{)793664}$	$46\overline{)284602}$	$97\overline{)102626}$	$88\overline{)671792}$

XIII

Addition—10 right in 3 minutes.

$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{3}{4}$	$\frac{11}{12}$	$\frac{11}{24}$	$\frac{1}{32}$	$\frac{7}{8}$	$\frac{5}{16}$
$\frac{3}{4}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{5}{8}$	$\frac{7}{12}$	$\frac{5}{8}$
$\frac{5}{8}$	$\frac{1}{6}$	$\frac{5}{12}$	$\frac{7}{12}$	$\frac{1}{3}$	$\frac{13}{16}$	$\frac{1}{2}$	$\frac{1}{12}$	$\frac{5}{24}$	$\frac{3}{16}$	$\frac{7}{24}$	$\frac{1}{4}$

XIV

Addition—12 right in eight minutes.

234	783	134	215	245	864	319	932
979	420	979	787	306	977	985	749
567	828	305	478	498	590	758	288
478	539	887	196	589	745	264	539
754	354	260	509	250	839	437	672
992	196	456	924	615	986	801	416
366	217	392	840	824	692	126	284
438	604	910	382	707	548	598	219
329	975	129	623	191	704	677	704

577	205	586	170	208	217	586	359
194	110	324	676	984	173	324	235
538	324	247	505	352	538	247	714
636	638	174	237	745	625	170	129
860	411	958	458	497	209	958	647
575	539	435	722	176	994	435	280
751	747	913	384	569	380	913	486
402	156	692	899	623	456	692	592
389	200	709	968	838	661	709	678

XV

This exercise contains the 90 subtraction facts—All right in 5 minutes.

80314927	8760051	4003347	82364354
46349441	2273528	2712617	35845858

8590323	42754101	2558496	93832917
5962665	32851519	1412743	32105144

7598719	76697666	9562145	80802121
4887916	22416569	9208247	65887712

XVI

Multiplication—11 right in six minutes.

2143	4079	6785	9809	9786	6739	4921	9524
89	57	96	42	45	19	73	58

6785	7568	3478	3484	3792	3098	8742	5624
24	83	92	208	57	67	360	18

XVII

These examples contain all the multiplication facts—All right in six minutes.

45239	53429	60871	39245	87160	71608
278	951	273	436	916	845

XVIII

Division—11 right in eight minutes.

$28\overline{)8204}$	$65\overline{)45825}$	$58\overline{)51736}$	$94\overline{)38634}$	$47\overline{)39997}$
$36\overline{)23076}$	$74\overline{)48100}$	$25\overline{)12075}$	$93\overline{)69006}$	$76\overline{)29184}$
$49\overline{)34986}$	$52\overline{)14196}$	$34\overline{)31960}$	$85\overline{)28685}$	$56\overline{)45304}$

XIX

Subtraction—All right in three minutes.

$2\frac{7}{8}$	$6\frac{15}{16}$	$2\frac{11}{12}$	$9\frac{5}{8}$	$6\frac{1}{2}$	$16\frac{1}{2}$	24	$18\frac{1}{4}$
$1\frac{3}{4}$	$3\frac{7}{8}$	$1\frac{2}{3}$	$6\frac{1}{2}$	$2\frac{3}{4}$	$12\frac{3}{4}$	$15\frac{3}{8}$	$16\frac{1}{2}$

$3\frac{1}{3}$	100	$100\ \%$	200	200	$50\ \%$	$75\ \%$	$12\frac{1}{2}$
$2\frac{1}{4}$	$66\frac{2}{3}$	$62\frac{1}{2}\%$	$137\frac{1}{2}$	$187\frac{1}{2}$	$33\frac{1}{3}\%$	$37\frac{1}{2}\%$	$7\frac{15}{16}$

$18\frac{2}{3}$	$50\ ¢$	$25\ \%$	$\frac{1}{4}$	$87\frac{1}{2}\%$	$\frac{7}{8}$	$16\frac{2}{3}\%$	$\frac{1}{6}$
$5\frac{3}{4}$	$12\frac{1}{2}¢$	$8\frac{1}{3}\%$	$\frac{1}{12}$	$16\frac{2}{3}\%$	$\frac{1}{6}$	$6\frac{1}{4}\%$	$\frac{1}{16}$

XX

Use of Signs—All right in five minutes.

1. $(8 \times 4) + (3 \times 5) = ?$
2. $5 + (8 \times 5) = ?$
3. $(6 \div 2) + (3 \times 10) = ?$
4. $(15 \div 5) + (21 \div 7) = ?$
5. $(24 \div 6) - (34 \div 17) = ?$
6. $25 \times 2 \div 10 = ?$
7. $18 \div 6 \times 5 = ?$
8. $27 \div 3 \times 4 - 5 = ?$
9. $25 - 10 + 5 = ?$
10. $18 + (4 \div 2) = ?$
11. $36 - (18 \div 6) = ?$
12. $(3 \times 4) + (8 \times 5) - (12 \div 6) = ?$
13. $(5 \times 6) - (2 + 4) + (7 \times 2) = ?$
14. $(6 \times \frac{1}{2}) + (8 \div 4 \times 7) = ?$
15. $(7 \times 8 \div 4) - (6 \times 2) - (8 \div 8) = ?$
16. $3 \times 52 + 7 = ?$
17. $(18 + 6) + (7 \times 4) - (24 \div 8 \times 4) = ?$
18. $(8 + 4) \times (16 - 12) = ?$
19. $(7 - 3) \times (8 + 2) - (6 \div 2) = ?$
20. $(14 \div 2) + (4 - 3) + (6 \times 8) = ?$

XXI

There is an easy way to add the following by grouping certain numbers. Find it. Then add.

All right in six minutes.

84%	$2\frac{1}{5}$	$64\frac{3}{8}$	$16\frac{2}{3}$	175	$37\frac{1}{2}$	$\frac{1}{3}$	$\frac{5}{6}$	15
16%	$3\frac{1}{2}$	$25\frac{1}{4}$	$8\frac{1}{12}$	225	$62\frac{1}{2}$	$\frac{5}{8}$	$\frac{7}{12}$	34
65%	$4\frac{3}{4}$	$19\frac{1}{2}$	$15\frac{1}{4}$	845	50	$\frac{1}{6}$	$\frac{1}{4}$	25
27%	$5\frac{4}{5}$	$65\frac{7}{8}$	$22\frac{1}{2}$	155	$33\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{2}$	66
73%	$8\frac{1}{4}$	19	$34\frac{1}{6}$	450	40	$\frac{3}{8}$	$3\frac{1}{3}$	85
35%	$6\frac{1}{2}$	$24\frac{1}{8}$	30	350	$66\frac{2}{3}$	$\frac{1}{4}$	$4\frac{1}{2}$	50

XXII

These division examples require all the **multiplication facts** if the right answers are obtained.

All right in ten minutes.

$71608\overline{)60508760}$ $87160\overline{)79838560}$ $39245\overline{)17110820}$

$45239\overline{)12576442}$ $53429\overline{)50810979}$ $60871\overline{)16617783}$

XXIII

A Fraction Test

Read across the page, write answers only.

100 right in thirty minutes.

	a	b	c	d	e
1.	$\frac{1}{2}+\frac{1}{4}$	$\frac{1}{4}+\frac{1}{8}$	$\frac{1}{3}+\frac{1}{6}$	$\frac{1}{5}+\frac{1}{10}$	$\frac{1}{3}+\frac{1}{4}$
2.	$\frac{3}{4}+\frac{1}{8}$	$\frac{2}{3}+\frac{1}{6}$	$\frac{2}{5}+\frac{1}{10}$	$\frac{2}{3}+\frac{1}{9}$	$\frac{1}{3}+\frac{2}{9}$
3.	$\frac{1}{2}-\frac{1}{4}$	$\frac{1}{4}-\frac{1}{8}$	$\frac{3}{4}-\frac{5}{8}$	$\frac{1}{5}-\frac{1}{10}$	$\frac{2}{5}-\frac{3}{10}$
4.	$\frac{1}{3}-\frac{1}{6}$	$\frac{1}{3}-\frac{1}{9}$	$\frac{2}{3}-\frac{1}{6}$	$\frac{2}{3}-\frac{4}{9}$	$\frac{2}{3}-\frac{1}{2}$
5.	$\frac{1}{2}\times 3$	$\frac{1}{3}\times 4$	$\frac{1}{4}\times 6$	$\frac{1}{5}\times 6$	$\frac{1}{6}\times 4$
6.	$\frac{2}{3}\times 4$	$\frac{3}{4}\times 4$	$\frac{5}{6}\times 4$	$\frac{2}{5}\times 4$	$\frac{3}{5}\times 5$
7.	$\frac{3}{5}\div 3$	$\frac{6}{12}\div 2$	$\frac{8}{9}\div 4$	$\frac{12}{16}\div 3$	$\frac{18}{25}\div 6$
8.	$\frac{1}{2}\div\frac{1}{2}$	$\frac{1}{2}\div\frac{1}{3}$	$\frac{1}{3}\div\frac{1}{2}$	$\frac{2}{3}\div\frac{3}{4}$	$\frac{3}{4}\div\frac{2}{3}$
9.	$\frac{2}{3}\div 2$	$\frac{1}{3}\div 2$	$\frac{3}{5}\div 4$	$\frac{5}{3}\div 3$	$\frac{3}{4}\div 5$
10.	$\frac{2}{5}+\frac{3}{10}$	$\frac{7}{10}+\frac{2}{5}$	$\frac{7}{10}\times 5$	$\frac{18}{9}\div 9$	$\frac{5}{8}\times\frac{1}{2}$
11.	$\frac{1}{2}-\frac{3}{8}$	$\frac{4}{5}\times 4$	$\frac{21}{2}\div 3$	$\frac{1}{4}+\frac{1}{3}$	$\frac{1}{3}-\frac{1}{4}$

	a	b	c	d	e
12.	$2\frac{1}{5}\times 4$	$15\frac{5}{8}\div 5$	$\frac{1}{2}+2\frac{1}{4}$	$1\frac{1}{2}-\frac{3}{4}$	$\frac{2}{3}\times\frac{9}{16}$
13.	$3\frac{3}{4}\div 3$	$8\frac{4}{7}\div 4$	$10\frac{5}{8}\div 5$	$12\frac{8}{9}\div 4$	$18\frac{2}{3}\div 6$
14.	$\frac{21}{4}\div 7$	$\frac{6}{7}\div 6$	$\frac{12}{16}\div 4$	$\frac{24}{25}\div 8$	$\frac{27}{28}\div 9$
15.	$\frac{3}{5}-\frac{1}{10}$	$2\frac{1}{2}-1\frac{1}{4}$	$3\frac{1}{3}+2\frac{1}{6}$	$\frac{4}{9}\times\frac{6}{12}$	$\frac{1}{10}\div\frac{3}{5}$
16.	$\frac{1}{8}+\frac{1}{2}$	$\frac{1}{6}+\frac{1}{2}$	$\frac{1}{10}+\frac{1}{2}$	$\frac{5}{6}+\frac{2}{3}$	$\frac{3}{8}+\frac{1}{2}$
17.	$\frac{5}{6}-\frac{1}{3}$	$\frac{5}{8}-\frac{1}{3}$	$\frac{5}{6}-\frac{2}{3}$	$\frac{7}{9}-\frac{2}{3}$	$\frac{5}{6}-\frac{1}{2}$
18.	$\frac{4}{5}\times 3$	$\frac{2}{5}\times 6$	$\frac{1}{7}\times 9$	$\frac{2}{7}\times 5$	$\frac{3}{7}\times 3$
19.	$\frac{1}{2}\times\frac{2}{3}$	$\frac{3}{4}\times\frac{2}{3}$	$\frac{5}{8}\times\frac{2}{5}$	$\frac{3}{8}\times\frac{4}{9}$	$\frac{3}{4}\times\frac{5}{12}$
20.	$\frac{1}{2}-\frac{3}{10}$	$\frac{1}{2}+\frac{3}{4}$	$\frac{1}{2}\div\frac{5}{6}$	$\frac{1}{2}+\frac{5}{8}$	$\frac{1}{2}+\frac{7}{10}$
21.	$\frac{3}{4}+\frac{1}{6}$	$\frac{7}{8}-\frac{3}{4}$	$8\times\frac{3}{16}$	$\frac{8}{9}\times 3$	$5\div 2\frac{1}{2}$
22.	$2\frac{1}{2}\times 8$	$\frac{3}{4}+\frac{5}{16}$	$\frac{9}{10}\div\frac{2}{5}$	$\frac{3}{4}\div 4$	$7\div 1\frac{1}{2}$
23.	$6-1\frac{1}{2}$	$\frac{5}{8}-\frac{13}{24}$	$\frac{5}{6}+1\frac{3}{4}$	$2\frac{1}{2}+2\frac{3}{4}$	$2\times 5\frac{3}{4}$

XXIV

Write on another sheet each of the following quotients with the decimal point properly placed.

All right in three minutes.

(1) $\begin{array}{r}1\\12\overline{).12}\end{array}$	(2) $\begin{array}{r}1\\.1\overline{)10}\end{array}$	(3) $\begin{array}{r}2\\1.2\overline{)2.4}\end{array}$	(4) $\begin{array}{r}5\\.24\overline{).120}\end{array}$
(5) $\begin{array}{r}2\\.25\overline{)50}\end{array}$	(6) $\begin{array}{r}5\\.7\overline{)3.5}\end{array}$	(7) $\begin{array}{r}8\\.7\overline{).56}\end{array}$	(8) $\begin{array}{r}1\\.25\overline{).25}\end{array}$
(9) $\begin{array}{r}1\\.8\overline{)8}\end{array}$	(10) $\begin{array}{r}4\\.9\overline{)0.36}\end{array}$	(11) $\begin{array}{r}1\\.3\overline{)3}\end{array}$	(12) $\begin{array}{r}4\\.021\overline{).84}\end{array}$
(13) $\begin{array}{r}4\\81\overline{)3.24}\end{array}$	(14) $\begin{array}{r}1\\.3\overline{).30}\end{array}$	(15) $\begin{array}{r}5\\.005\overline{)25}\end{array}$	(16) $\begin{array}{r}32\\.25\overline{)800}\end{array}$
(17) $\begin{array}{r}85\\8.5\overline{)722.5}\end{array}$	(18) $\begin{array}{r}4\\9\overline{).036}\end{array}$	(19) $\begin{array}{r}82\\.4\overline{)3.28}\end{array}$	(20) $\begin{array}{r}21\\1.9\overline{).0399}\end{array}$

XXV

In each of the following, write the quotient without rewriting the example if possible.

40 right in ten minutes.

	a	b	c
1.	$12 \div 12 = ?$	$.12 \div 12 = ?$	$.01 \div .001 = ?$
2.	$10 \div .1 = ?$	$75 \div 25 = ?$	$75 \div .25 = ?$
3.	$84 \div 840 = ?$	$84 \div 8.4 = ?$	$.84 \div 21 = ?$
4.	$3.24 \div 81 = ?$	$.84 \div .021 = ?$	$3 \div \frac{1}{3} = ?$
5.	$3 \div .3 = ?$	$30 \div .03 = ?$	$.30 \div .3 = ?$
6.	$2.4 \div 1.2 = ?$	$1.2 \div 2.4 = ?$	$.12 \div .24 = ?$
7.	$.12 \div 2.4 = ?$	$.036 \div 9 = ?$	$0.36 \div .9 = ?$

	a	b	c
8.	$36 \div 90 = ?$	$15 \div 150 = ?$	$27 \div 2.7 = ?$
9.	$4 \div 40 = ?$	$.4 \div .04 = ?$	$40 \div 4. = ?$
10.	$100 \div .25 = ?$	$800 \div .25 = ?$	$250 \div 50 = ?$
11.	$50 \div 250 = ?$	$16 \div 64 = ?$	$3.5 \div .7 = ?$
12.	$45 \div .9 = ?$	$4.5 \div .9 = ?$	$.02 \div .1 = ?$
13.	$56 \div .7 = ?$	$.7 \div .14 = ?$	$2.5 \div 25 = ?$
14.	$25 \div .25 = ?$	$2.5 \div .25 = ?$	$.25 \div .25 = ?$
15.	$80 \div .8 = ?$	$8.0 \div .8 = ?$	$8 \div 80 = ?$

XXVI

Review the short methods in multiplication, then solve the following examples in the most economical way. Time yourself.

	a	b	c
1.	$76 \times 25 = ?$	$99 \times 33\frac{1}{3} = ?$	$\$11.25 \times 40 = ?$
2.	$800 \times 62 = ?$	$75 \times 75 = ?$	$7\frac{1}{2} \times 7\frac{1}{2} = ?$
3.	$1200 \times 2\frac{3}{4} = ?$	$\$18.75 \times 20 = ?$	$16\frac{2}{3} \times 240 = ?$
4.	$16\frac{2}{3}\% \times 18 = ?$	$16\frac{2}{3} \times 48 = ?$	$12\frac{1}{2} \times 64 = ?$
5.	$12\frac{1}{2}\% \times 84 = ?$	$12 \times 66\frac{2}{3} = ?$	$65 \times 19 = ?$
6.	$49 \times 51 = ?$	$99 \times 7 = ?$	$.02\frac{1}{2} \times 16 = ?$
7.	$.03\frac{1}{3} \times 90 = ?$	$.96\frac{2}{3} \times 300 = ?$	$101\% \times 70 = ?$
8.	$125\% \times 16 = ?$	$11 \times \$120 = ?$	$25 \times \$36 = ?$
9.	$\$55 \times 55 = ?$	$95 \times \$95 = ?$	$24.75 \times 4 = ?$
10.	$25\% \times \$40.40 = ?$	$99 \times 64 = ?$	$39 \times 61 = ?$
11.	$1.8 \times \$600 = ?$	$.19 \times 300 = ?$	$2\frac{1}{2} \times 2\frac{1}{2} = ?$
12.	$12 \times 144 = ?$	$35 \times 35 = ?$	$125 \times 6.4 = ?$
13.	$133\frac{1}{3}\% \times 900 = ?$	$125\% \times 12 = ?$	$200\% \times \$25.75 = ?$
14.	$.00\frac{1}{2} \times \$1000 = ?$	$\frac{3}{4}\% \times 1600$ ft. $= ?$	$.05\% \times \$10000 = ?$
15.	$175\% \times 44 = ?$	$15 \times 150 = ?$	$115 \times 115 = ?$

XXVII

Name the missing numbers.

The correct answer for No. 1 is "3 is $\frac{1}{2}$ of 6, or $\frac{1}{4}$ of 12, or 6% of 50, or $2 \times 1\frac{1}{2}$."

1. 3 is $\frac{1}{2}$ of __, or $\frac{1}{4}$ of __, or 6% of __, or $2\times$__
2. 10 is $\frac{2}{5}$ of __, or .1 of __, or $5\times$__, or $\frac{1}{6}$ of __
3. 50 is $\frac{2}{3}$ of __, or $1\frac{2}{3}\times$__, or $2\frac{1}{2}\times$__, or 20% of __
4. 24 is $\frac{4}{3}$ of __, or 75% of __, or 40% of __, or $2\frac{2}{3}\times$__
5. $\frac{1}{4}$ is $\frac{1}{2}$ of __, or $\frac{1}{3}$ of __, or $3\times$__, or 50% of __
6. 27 is $\frac{3}{4}$ of __, or $33\frac{1}{3}$% of __, or $2\frac{1}{4}\times$__, or $1\frac{1}{2}\times$__
7. $\frac{3}{4}$ is $\frac{1}{3}$ of __, or $3\times$__, or 100% of __, or $4\times$__
8. 18 is $\frac{2}{3}$ of __, or $\frac{3}{4}$ of __, or $12\frac{1}{2}$% of __, or .6 of __
9. .8 is $\frac{4}{5}$ of __, or $2\times$__, or 50% of __, or $16\frac{2}{3}$% of __
10. 25 is 20% of __, or 25% of __, or 4% of __, or $2\frac{1}{2}\times$__
11. 14 is $3\frac{1}{2}\times$__, or $\frac{2}{3}$ of __, or $\frac{7}{8}$ of __, or 25% of __
12. 90 is $.9\times$__, or 10% of __, or $2\frac{1}{4}\times$__, or $\frac{2}{3}$ of __

XXVIII

Find the average and the median.

1. $2\frac{3}{4}$, $3\frac{1}{2}$, $6\frac{1}{4}$, 4, $2\frac{1}{2}$
2. 8.5, 6.3, 7.2, 9.4, 6.1
3. .84, .75, .62, .56, .80
4. 80%, 90%, 85%, 95%, 88%
5. 60¢, 48¢, 55¢, 60¢, 50¢
6. 48.3 yd., 52.8 yd., 50.7 yd.
7. 8 yr. 6 mo., 9 yr. 3 mo., 10 yr. 2 mo.
8. 5 ft. 4 in., 5 ft. 8 in., 5 ft. 1 in.
9. $16\frac{1}{2}$ lb., $18\frac{3}{4}$ lb., $19\frac{1}{2}$ lb., $15\frac{1}{4}$ lb., 17 lb.
10. $125, $140, $122, $132, $135

XXIX

Find the missing number.

1. $3 = ______ 25¢
2. $8 = $12\frac{1}{2}$¢ × ______
3. 4 × $37\frac{1}{2}$¢ = ______
4. $12 = ______ 50¢
5. $2.25 = ______ × 25¢
6. $22.50 = $2.25 × ______
7. $30 = ______ × $3.75
8. $50 = ______ × $2.50
9. $2 = ______ × $8\frac{1}{3}$¢
10. $1.50 = ______ × $12\frac{1}{2}$¢
11. $6.25 = 25¢ × ______
12. 15 × $2.50 = ______
13. 16 × $2.25 = ______
14. 24 × $37\frac{1}{2}$¢ = ______
15. 32 × $62\frac{1}{2}$¢ = ______
16. $60 = ______ × 75¢

XXX

Are you 100% efficient in computation?

This test is given to those seeking employment in a certain department store in a large city. The passing mark is 100. The time must not exceed 10 minutes.

Try to solve all right in less than 10 minutes.

1.
```
  98773
  37521
  46378
  73216
  53764
 +21976
 ------
   Ans.
```

2.
```
  74621
 -43130
 ------
   Ans.
```

3.
```
  75412
     ×8
 ------
   Ans.
```

4.
```
  98744
    ×78
 ------
   Ans.
```

5.
```
 9)13437659
       Ans.
```

6. Find the cost of each of the following:

(1) 9 yd. gingham @ $12\frac{1}{2}$¢ Ans.

(2) $12\frac{1}{2}$ yd. muslin @ 22¢ Ans.

(3) 4 pr. lace curtains @ $3.75 pr.
Less 10% discount Ans.

(4) $15\frac{1}{4}$ yd. lace @ $12\frac{1}{2}$¢ yd.
Less 25% discount Ans.

CHAPTER II

SQUARES AND SQUARE ROOTS

1. The square of a number is the product obtained by using the number twice as a factor.

9 is the square of 3 because $3\times3=9$. The product may be indicated by writing 2 (called the exponent) a little to the right and above the number to be squared, as $3\times3=3^2$. Such an expression is read 3 squared, or the square of 3.

2. The square root of a number is one of the two equal factors of that number.

4 is the square root of 16 because 4 is one of the two equal factors of 16. The sign of square root is $\sqrt{}$. The square root of a number may be indicated by writing the sign over the number, as $\sqrt{16}$.

3. Write in a column the squares of all the numbers from 1 to 13, and of all the numbers ending in zero between 10 and 100.

4. Recall the short method of squaring numbers ending in 5.

5. Write in three columns the squares

(1) Of all integers ending in 5 from 15 to 125.

(2) Of all pure decimals of two places ending in 5 from .05 to .95.

(3) Of all mixed decimals of one decimal place ending in 5 from 1.5 to 12.5.

Use this table when you extract square root.

6. Show by example the truth of these statements.

(1) The squares of all numbers between 1 and 10 lie between 1 and 100.

(2) The squares of all numbers between 10 and 100 lie between 100 and 10,000.

(3) The square of a proper fraction is a proper fraction less in value than the fraction squared. $(\frac{3}{4})^2 = \frac{9}{16}$.

(4) The square of a decimal fraction is a decimal fraction with twice as many decimal places as the fraction squared; therefore, an even number of places. $.9^2 = .81$.

(5) The square of a mixed number is a mixed number.

(6) The square root of a decimal fraction has one half as many decimal places as the decimal fraction whose root is extracted. $\sqrt{.49} = .7$.

(7) The square root of a proper fraction has a larger value than the fraction, but it is always less than one.

(8) The square roots of numbers between 100 and 10,000 lie between 10 and 100.

(9) The square roots of numbers between 1 and 100 lie between 1 and 10.

7. Observations.

(1) Perfect squares (numbers whose square root can be found exactly) ending in 25 have their root ending in 5. $\sqrt{4225} = 65$.

(2) Perfect squares ending in 6 have their root ending in 4 or 6. $\sqrt{16} = 4$. $\sqrt{36} = 6$.

(3) Perfect squares ending in 9 have their root ending in 3 or 7. $\sqrt{169} = 13$. $\sqrt{289} = 17$.

(4) Perfect squares ending in 1 have their root ending in 1 or 9. $\sqrt{121} = 11$. $\sqrt{81} = 9$.

(5) Perfect squares ending in 4 have their root ending in 2 or 8. $\sqrt{64} = 8$. $\sqrt{144} = 12$.

(6) No perfect square can end in one zero, 2, 3, 7, or 8.

(7) No perfect square can end in 15, 35, 45, 55, etc.

Extracting Square Root by Long Division

By this method extracting square root consists in finding a divisor which is equal to the quotient when the dividend is the number whose square root is to be extracted.

I. Of perfect squares.

1. Extract the square root of 9801.

$$\begin{array}{r} 99 \\ 99\overline{)9801} \\ \underline{891} \\ 891 \end{array}$$

The square root must lie between 95 and 100. Why? What is the square of 95? Assuming 9801 to be a perfect square, try 99 as a divisor. Divide 9801 by 99.

99 is the square root of 9801. Why?

In case of perfect squares whose square root does not exceed two places the root can be determined exactly upon the first trial by keeping in mind the observations on page 167 and remembering the squares of the numbers ending in 0 and 5.

2. Extract the square root of 6084.

$$\begin{array}{r} 78 \\ 78\overline{)6084} \\ \underline{546} \\ 624 \end{array}$$

The root lies between 75 and 80. Why? After you have observed the last digit in 6084, inspection shows the root to be 78, assuming 6084 to be a perfect square. Actual division proves the correctness of the inspection.

3. Extract the square root of 6.76.

$$\begin{array}{r} 2.6 \\ 2.6\overline{)6.76} \\ \underline{5.2} \\ 1.56 \end{array}$$

Assuming 6.76 to be a perfect square, try 2.6, because $2.5^2=6.25$ and $3^2=9$.

4. Extract the square root of .6889.

$$\begin{array}{r} .83 \\ .83\overline{).6889} \\ \underline{.664} \\ 249 \end{array}$$

Try .83. $.8^2=.64$ and $.85^2=.7225$.

The solutions on page 168 represent the 3 types of perfect squares whose roots may be extracted accurately by inspection at the first trial.

5. These numbers are perfect squares. Estimate the square root of each. Then prove your estimate by division.

	a	b	c	d	e
(1)	1369	9409	2809	8281	1156
(2)	1521	1225	7225	9025	2209
(3)	3721	5329	6241	5776	8649
(4)	289	4489	676	961	6561
(5)	7569	3364	3481	4356	1764
(6)	6084	5625	841	361	2025
(7)	3025	6889	4225	2704	529

6. Remembering that the square root of a decimal fraction is a decimal with only one half as many decimal places, find by the method of inspection and long division the square root of each of the following perfect decimal squares.

	a	b	c	d	e
(1)	.3025	.0484	.7225	.9025	.9409
(2)	.4225	.6241	.5625	.2025	.3364
(3)	.4489	.0625	.2704	.3136	.1225
(4)	.1681	.2809	.6084	.3721	.5329

7. The following mixed decimals are perfect squares. Find their square root. Remember the decimal point. Check your answer.

	a	b	c	d
(1)	42.25	30.25	6.25	92.16
(2)	1.96	1.69	90.25	51.84
(3)	10.89	32.49	5.29	86.49
(4)	15.21	29.16	21.16	75.69

II. Extracting the square root of imperfect squares.

People who must often know the square root of imperfect squares use a table like the one on page 302. If a table is not convenient, use the method of inspection and long division as shown in example 1.

1. Extract the square root of 23.

$$\begin{array}{r|l} & 4.79+ \\ 4.8 & \overline{23.00} \\ & 19.2 \\ \hline & 3.80 \\ & 3.36 \\ \hline & .440 \end{array}$$

Inspection shows the root to lie between 4.5 and 5. What is the square of 4.5? The root is nearer 5 than 4.5. How may you know this? Try 4.8. Compare the quotient with the divisor. Have you found the square root? For practical purposes a square root carried to tenths is accurate enough in ordinary work. If you find your first estimate not accurate enough, use it to help you make another one.

2. The sign $\sqrt{\ }$ means extract the square root. In integers and mixed decimals, carry the root to tenths; in pure decimals, to hundredths. Remember the decimal point. Many pupils have estimated correctly on the first trial in most examples of this list. Check your answer.

	a	b	c	d	e
(1)	$\sqrt{34}=?$	$\sqrt{9125}=?$	$\sqrt{.9}=?$	$\sqrt{.7}=?$	$\sqrt{1525}=?$
(2)	$\sqrt{3.4}=?$	$\sqrt{7325}=?$	$\sqrt{.2250}=?$	$\sqrt{.4}=?$	$\sqrt{3000}=?$
(3)	$\sqrt{79}=?$	$\sqrt{125}=?$	$\sqrt{.036}=?$	$\sqrt{90}=?$	$\sqrt{285}=?$
(4)	$\sqrt{70}=?$	$\sqrt{42.9}=?$	$\sqrt{.5648}=?$	$\sqrt{36.8}=?$	$\sqrt{25.6}=?$

III. Extracting the square root of common fractions and mixed numbers.

NOTE.—If both numerator and denominator of a fraction are perfect squares, extract the square root of each term, as $\sqrt{\frac{9}{4}}=\frac{3}{2}$. In all other cases reduce the fraction to a decimal, and proceed as you did above. $\sqrt{\frac{2}{3}}=\sqrt{.66+}=.8+$. $\sqrt{3\frac{1}{4}}=\sqrt{3.25}=1.8+$.

CHAPTER III

USING SQUARES AND SQUARE ROOTS

The Right Triangle

1. Draw a right triangle whose base is 4 in. and whose altitude is 3 in. Measure the long side, called the hypotenuse. The figure you drew is called the 3-4-5 (Read three four five) triangle. It occurs frequently in problems, and therefore should be carefully studied.

2. Erect squares on the three sides of the triangle you drew in problem 1. What is the relation as regards area between the large square and the other two?

3. Draw to some convenient scale the right triangle whose sides are 9 in., 12 in., and 15 in. Erect squares as you did in problem 2. What is the relation between the largest square and the other two?

4. The square on the hypotenuse of a certain right triangle contains 100 sq. in. The square on the altitude contains 36 sq. in. What is the area of the square on the base? How long is the base?

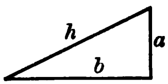
5. Beginning at one corner of the floor of your schoolroom measure on the floor along one wall exactly 6 feet, making a mark at the end of the 6-foot line. Then from the same corner measure on the floor along the other wall exactly 8 feet, making a mark at the end of the 8-foot line. Now connect the two points with a stiff cord and measure the length of the cord between the two points. What do you find? What is the name of this line?

The truth illustrated in the previous problems may be called the "Rule of the Right Triangle." It may be stated in this way,

The square on the hypotenuse of any right triangle is equal to the sum of the squares on the two other sides.

Expressing the Rule of the Right Triangle in a Formula

1. A formula is a rule stated in letters.



2. In right triangles, h stands for the hypotenuse, a stands for the altitude, and b for the base. See the figure.

When used in formulas, these letters stand for abstract numbers. If in a given formula h represents feet, then a and b must also represent feet.

3. The rule of the right triangle may be expressed in these ways. Tell the meaning of each from the figure.

(1) $h^2 = a^2 + b^2$; $h = \sqrt{a^2+b^2}$
(2) $a^2 = h^2 - b^2$; $a = \sqrt{h^2-b^2}$
(3) $b^2 = h^2 - a^2$; $b = \sqrt{h^2-a^2}$

4. Find h when $a = 4$ and $b = 3$.

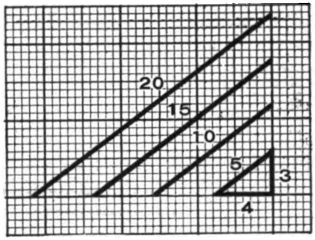
$$h^2 = \sqrt{4^2+3^2}. \quad h = \sqrt{25} \text{ or } 5.$$

Solve these right triangles with the formula.

(1) Find h when $a = 20$ and $b = 21$; when $b = 33$ and $a = 56$.
(2) Find a when $h = 53$ and $b = 45$; when $h = 89$ and $b = 80$.
(3) Find b when $a = 36$ and $h = 85$; when $a = 44$ and $h = 125$.

One of the triangles in the next list is not a right triangle. Find it and prove your answer.

(1) $a = 5$, $b = 12$, $h = 13$.
(2) $a = 30$, $b = 40$, $h = 50$.
(3) $a = 12$, $b = 12$, $h = 15$.
(4) $a = 15$, $b = 36$, $h = 39$.



1. From the 3-4-5 triangle in the figure find by inspection the base and altitude of each triangle whose hypotenuse is shown.

2. How do the triangles in the figure resemble each other? How are they different?

3. Write the sides of three other triangles which belong to this group.

4. By remembering the 3-4-5 triangle, you can often solve problems by inspection (without use of pencil). Try this on the following right triangles.

5. Base, 21 feet; altitude, 28 feet. Find hypotenuse.

HINT.—By what must you multiply the dimensions of the 3-4-5 triangle to make a 21-28 (x) triangle?

6. Base, 24 in.; altitude, 32 in. Find hypotenuse.

7. Hypotenuse, 45 feet; altitude, 36 feet. Find the base.

8. Hypotenuse, $1\frac{1}{4}$ inches; base, 1 inch. Find the altitude.

9. Find the diagonal of a rectangle 42 ft. wide and 56 ft. long.

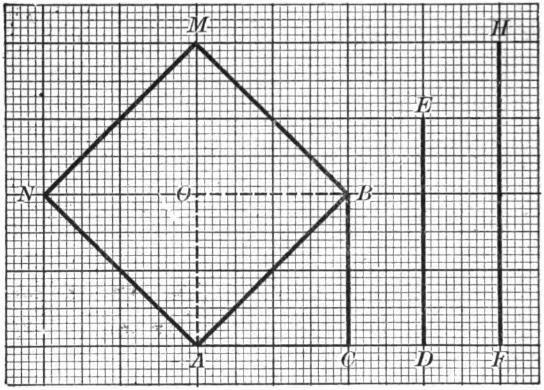
10. The diagonal of a rectangular field is 100 rods; its width is 60 rods. Find the length.

11. If your schoolroom is 32 ft. by 24 ft., find the diagonal of the ceiling. Pupils who know the 3-4-5 triangle do not need a pencil in this problem.

12. The diagonal of a rectangular lot is 115 ft. Its length is 92 ft. Find its width.

HINT.—23 is a common factor of 92 and 115. Therefore the triangle reduces to a 3-4-5 triangle.

The Isosceles Right Triangle



1. *ABC* is an isosceles right triangle. Why?

2. What relation exists between the square on the base and the one on the altitude?

3. What relation is there between the square on the hypotenuse and the square on either one of the equal sides?

4. *AB* is also the diagonal of the square *AOBC*.

5. If the diagonal of the square in the figure is 10 feet, can you find the area of the square without finding the length of one side of the square? How? What is the area of the square *ABMN*? Of *AOBC*?

6. From the figure and your work write a rule for finding the area of any square when you know its diagonal.

7. *DE* represents the height of a tree from the ground to the first limb. How can you find the length of *DE* by using the triangle *ABC*? If *HF* is a telephone pole, can you find its height by means of *ABC*? Do it.

8. Some boys wished to know how they might measure the height of trees, towers, telephone poles, etc. This is the way their teacher told them to proceed.

I. Constructing the Apparatus

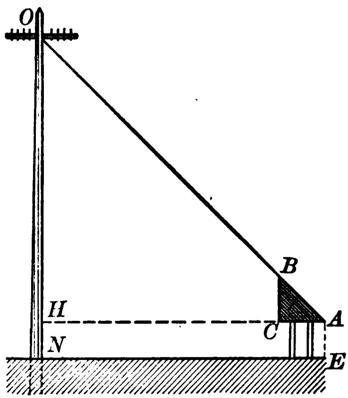
(1) Cut from heavy cardboard, or a thin board, an isosceles right triangle such as ABC in the figure on page 174.

(2) Mount this triangle on a level stand of convenient height.

II. Using the Apparatus

Problem. How high from the ground is the cross piece of the telephone pole near school?

(1) Set the apparatus on a level at such a distance that the line AB is in line with O, the upper extremity of the vertical distance to be measured. See figure.



(2) The line AH is horizontal and at right angles to the telephone pole in the figure. Why?

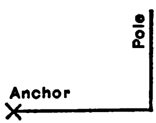
(3) The triangle AOH is isosceles right. Why?

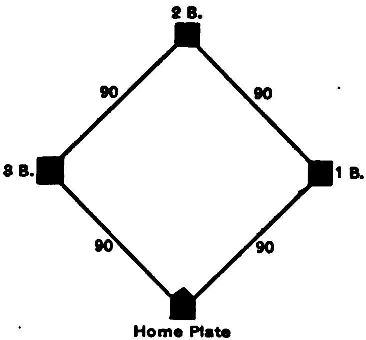
III. Computing the Result

(1) The distance of the cross piece at O from the ground at $N = AH + AE$. Why?

(2) How can you find the length of AH?

10. How long must a wire be to reach from the top of a pole 57 feet high to an anchor in the ground 76 feet from the foot of the pole?





11. A baseball diamond is 90 feet square.

(1) How far must the catcher, standing at the home plate, throw (measured on the ground) to reach the man at second base? Carry result to one decimal place.

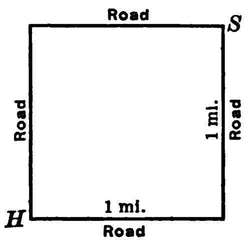
(2) How far is it from first base to third base?

(3) If the center fielder stands 100 feet directly behind second base, how far is he from the home plate?

(4) How far is it from the center of the diamond to third base?

(5) How far measured on the ground must a player bat a ball to make it strike 20 ft. to the left of the center fielder who stands 100 feet directly behind second base?

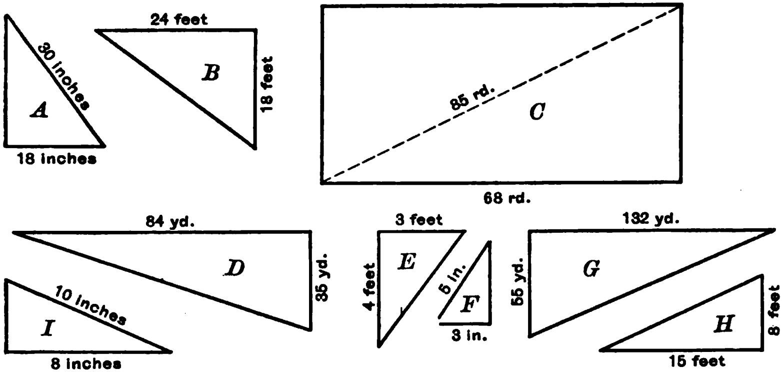
12. If a boy living at H, going to school at S, can go by way of the diagonal instead of over the roads, how much can he save in a school year of 200 days? If you express your answer in miles, carry it to 2 decimal places.



13. A girl walks $3\frac{1}{2}$ mi. due south and then $3\frac{1}{2}$ mi. due west. How far measured in a straight line is she from the starting point?

14. Two boys riding bicycles meet at a cross road. One is riding due east at 8 miles an hour, the other is going due south at 6 miles an hour. How far apart are they in $2\frac{1}{2}$ hours?

15. Find the length of a guy wire one end of which is attached to a 60-foot smoke stack 6 feet from the top. The other end is fastened at the ground 50 feet from the base of the stack. Allow 2 feet for slack wire.

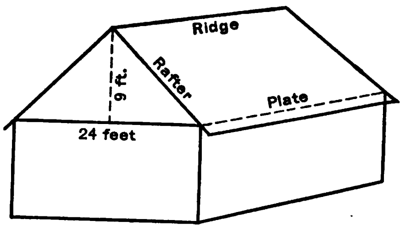


16. Find the unknown side and the area of each of the above figures. Find the unknown side by inspection.

17. Study this figure.

(1) How long must the rafters be to reach the plate?

(2) How long if they extend 18 in. beyond the plates?



(3) Find the area of the roof if its length is 49 ft?

18. How much lumber one inch thick will be required for the siding of the barn shown in the figure if it is 48 ft. long and 16 ft. high to the plate and if $\frac{1}{2}\%$ of that required for the gable ends must be added for waste in cutting? What will be the cost at $40 per M?

CHAPTER IV

USING FORMULAS IN PROBLEM SOLVING

A formula states a rule or principle in a short way.

In your work with circles you found that the area equals the square of the radius multiplied by π. This rule is expressed by the formula, $A = \pi R^2$. This formula tells you how to find the area of a circle if you know its radius. From it you can also find the radius of a circle if you know its area. The area is the product of two factors, of which you know one (π). The unknown factor is the square of the radius.

The general rule for interest is, "Multiply the principal by the rate by the number of years."

The formula for this rule is $I = P \times R \times T$. By explaining this formula as a product of three factors, you can solve directly from it the four interest problems, providing you know any three of these terms for each problem. One of these problems is, "Knowing the interest, the principal, and the rate, how do you find the time?" This is just another way of saying "Given the *product* of *three* factors, and knowing two of them, how do you find the third one?" What are the other problems?

In any formula, therefore, you can solve, without rewriting it, as many different types of problems as there are terms in the formula, provided at a given time all the terms but one are known.

The formulas of arithmetic are general rules expressed in terms of one of the four fundamental processes. Thus, **Loss = cost − selling price** is in thought a subtraction formula no matter which term is to be found.

Where a term is missing as indicated by the ?, name it and state how it may be found.

1. $S=a+b+c$, where $S=$ sum; a, b, c, are the addends.

(1) $? = a+b+c$. (2) $S = ? +b+c$.

2. $D=M-S$, where $D=$ difference or remainder, $M=$ minuend, $S=$ subtrahend.

(1) $? = M-S$. (2) $D=m-S$. (3) $D=M-?$

3. $P=M\times m$ (also written Mm), where $P=$ product, $M=$ multiplicand, $m=$ multiplier.

(1) $? = M\times m$. (2) $P=m\times m$. (3) $P=M\times ?$

4. $Q=D\div d$ (written also D), where $Q=$ quotient, $D=$ dividend and $d=$ divisor.

(1) $? = D\div d$. (2) $Q=?\div d$. (3) $Q=D\div ?$

The above formulas represent eleven types of problems which grow out of the four fundamental processes. These may be called fundamental problems because all the other arithmetic problems grow out of them.

Explain and solve each of these examples by stating (1) to which fundamental process the example belongs, (2) what is given, (3) what is to be found, (4) the value of the missing term which is called x for convenience.

(1) $3+7+8=x$
(2) $31=4+9+x$
(3) $84=100-x$
(4) $x=74-39$
(5) $75=x-24$
(6) $68\div 4=x$
(7) $x\div 5=20$
(8) $120\div x=24$
(9) $36\times x=144$
(10) $58\times 3=x$
(11) $x\times 6=42$
(12) $\frac{3}{4}\times x=24$
(13) $(3+8)-6=x$
(14) $x-(56+20)=24$

Solve the following problems by writing the proper equation (statement), after you have determined (1) what is wanted, (2) what is given, (3) the fundamental process to which the problem belongs.

1. A general merchant had a tank holding $44\frac{1}{2}$ gallons of oil. One day he drew out $15\frac{3}{4}$ gallons, and the next day, $9\frac{1}{8}$ gallons. How many gallons were left in the tank?

Thinking.—This is a problem in subtraction because we need to find the difference, knowing the minuend and subtrahend.

Statement.—Amt. left or x gal. $= 44\frac{1}{2}$ gal. $-(15\frac{3}{4}$ gal. $+ 9\frac{1}{8}$ gal.)

2. A common brick weighs about $4\frac{1}{2}$ lb. Find to the nearest 50 the number of bricks that a teamster should load to have approximately a ton.

3. In 1917, the production of gasoline in the United States was 68,000,000 bbl. In 1918, it was 85,000,000 bbl. Find the % of increase.

4. Find the cost of $8\frac{1}{2}$ doz. pencils at 25¢ per $\frac{1}{2}$ dozen.

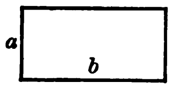
5. John had $1.20 on Monday. He earned 30 cents each day on Tuesday, Wednesday, Thursday, and Friday. Saturday morning he spent one third of what he had earned in the four days. Saturday afternoon his father gave John half as much as John then had. How much did his father give him?

6. The children of a school made small boxes to be filled with candy for a party. 600 were needed. Grades 3 to 7 made 20, 25, 83, 150, and 150 boxes. The 8th grade agreed to make the rest. How many did they agree to make?

7. At $2.01 per $100 of assessed valuation find the tax on an assessment of $434,733,255.

Formulas Used in Computing Lines and Surfaces

1. Rectangles.

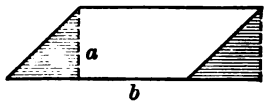


(1) $A = b \times a$, where A = area, b = base, a = altitude. In the rectangle, base and altitude are length and width. See figure.

(2) Write the formula which tells how to find the area of a square.

(3) Write the formula for the perimeter of a rectangle.

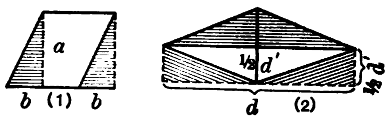
2. Rhomboids.



$A = b \times a$.

How would you find the base of a rhomboid, knowing its area and altitude?

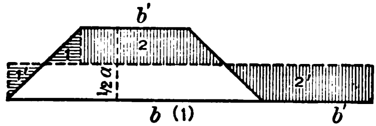
3. Rhombuses.



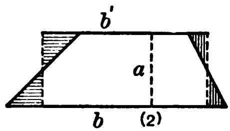
(1) $A = b \times a$.

(2) $A = d \times \frac{d'}{2}$ where d and d' are the diagonals.

4. Trapezoids.

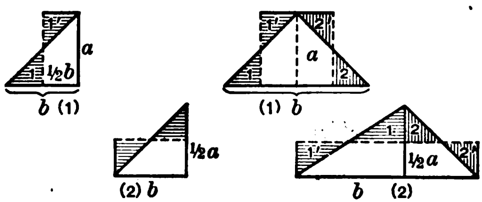


(1) $A = (b + b') \times \frac{a}{2}$, where b and b' are the bases.



(2) $A = \frac{b + b'}{2} \times a$.

5. Triangles.

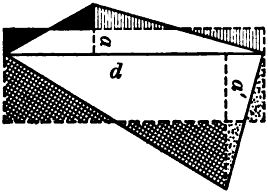


(1) $A = \frac{b}{2} \times a$.

(2) $A = b \times \frac{a}{2}$.

(3) Write the formula for the perimeter of an equilateral triangle.

NOTE.—The figures show how the formulas for area are derived from the equivalent rectangle. For a full discussion of this see Measuring Surfaces, pages 124-134.



6. Trapeziums.

$A = d \times \frac{a + a'}{2}$ where d = a diagonal, a and a' are the altitudes drawn to this diagonal.

7. Circles.

C, D, and R represent circumference, diameter, and radius.

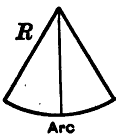
(1) $C = \pi \times D = 2\pi R$

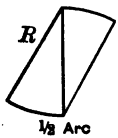
(2) $A = \frac{C}{2} \times R$

(3) $A = \pi R^2$

(4) $A = \frac{\pi D^2}{4}$

(5) $A = \frac{C^2}{4\pi}$



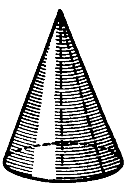


8. Sectors.

(1) $A = \frac{\text{arc}}{2} \times R$

(2) $A = \pi R^2 \times \frac{\text{central angle}}{360}$

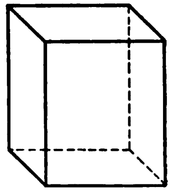
(3) $A = \pi R^2 \times \frac{\text{degrees in arc}}{360}$



9. Cones.

(1) Convex surface = s. h. (slant height) $\times \frac{C}{2}$.

(2) Entire surface = s. h. $\times \frac{C}{2}$ (convex surface) $+ \pi R^2$ (area of base).

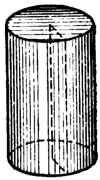


10. Prisms.

(1) Lateral surface $= P \times a$.

(2) Entire surface $= P \times a +$ area of 2 bases. $P =$ perimeter of base.

11. Cylinders.



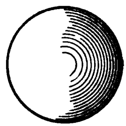
(1) Convex surface $= C \times a$.

(2) Entire surface $= C \times a$ (convex surface) $+ 2 \times \pi R^2$ (area of bases).

12. Spheres.

$S = \pi D^2 = 4\pi R^2$.

(1) $4\pi R^2$ means that the surface of a sphere is 4 times that of a circle whose radius is the radius of the sphere.



(2) What is the meaning of πD^2?

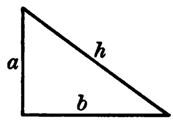
13. Right Triangles.

h, *b*, *a*, are hypotenuse, base and altitude. Tell the meaning of these formulas.

(1) $h = \sqrt{b^2 + a^2}$

(2) $b = \sqrt{h^2 - a^2}$

(3) $a = \sqrt{h^2 - b^2}$



(4) Write the formula which shows how to find the altitude of an equilateral triangle when one side is given.

(5) Write the formula which shows how to find the diagonal of a square if one side is known.

All terms in a mensuration formula are abstract. Therefore, in solving problems with such formulas all parts of the solution which involve a formula should be kept abstract.

1. Find the area of a circle whose radius is 8 ft.

FORMULA.—$A = \pi R^2$

SOLUTION.—$A = \frac{22}{7} \times 8 \times 8 \times 1$ sq. ft.

The area $= 201\frac{1}{7}$ sq. ft.

2. A lawn in the shape of a rhomboid is 50 feet long and 36 feet wide. How much will be the cost to sod it at 25¢ a square yard?

The formula employed in the solution is $A = b \times a$

SOLUTION.—Cost or $\$x = 25¢ \times \frac{50 \times 36}{9}$

$\$x = \$50.$

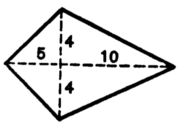
3. There are 40 acres in a rectangular field which is 40 rods wide. How long is it?

4. Find the area of a triangle whose base is 24 feet and whose altitude is 16 feet.

5. A triangle whose base is 25 feet contains 200 square feet. Find the altitude.

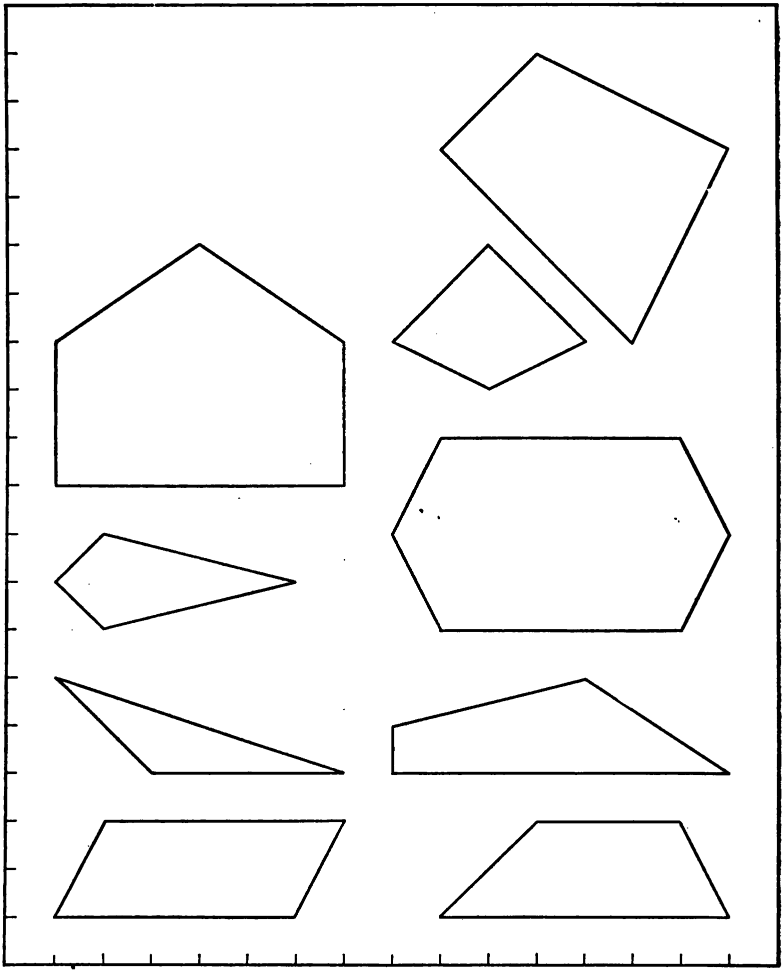
6. The lower base of a trapezoid is 20 feet; the upper is 16 feet; the altitude is 8 feet. Find the area.

7. A kite is in the form of a trapezium whose diagonals intersect each other at right angles as shown in the figure. Find the area and the perimeter.



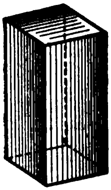
8. If the diameter of the moon is 2000 miles, what is the area of the portion visible to us at full moon?

9. Find the area of the earth, calling it a sphere whose diameter is 8000 miles. (Call π 3.1416.)



Compute the area of each of the figures within this rectangle. What % of the large rectangle is the sum of the areas of the figures within it?

Formulas Used in Computing Volumes



1. Rectangular prisms.

$V = h \times l \times w$, where h, l, and w represent height, length, and width.

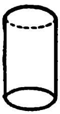
(1) What does the formula become when l and w are equal?

(2) Write the formula for the cube.

2. Cylinders.

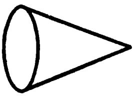
$V = B \times a$, where B represents the area of the base, and a the altitude.

(1) Write the formula when the diameter of the base and the altitude are given.



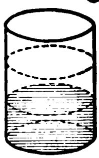
(2) Write the formula when the radius of the base and the altitude are given.

(3) How would you find the altitude of a cylinder, knowing the volume and the radius?



3. Cones.

$$V = \frac{B \times a}{3}$$



(1) What is the difference between this formula and that of the cylinder?

(2) Construct out of heavy paper a cylinder and a cone with equal altitudes and diameters. Observe by actual measurement with the use of sand or sawdust that you can fill the cone three times with the contents of the cylinder.

4. Spheres.

$$V = \frac{\pi}{6} \times D^3$$

This formula says that the volume of a sphere is a little more than $\frac{1}{2}$ of the cube of the diameter.

Read the problem carefully, then write the statement or tell the answer with the help of the preceding formulas.

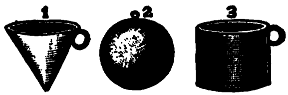
1. How many bushels of wheat in a rectangular bin 12 ft. long, 8 ft. wide, and 7 ft. high if 1 cu. ft. = .8 bushel?

2. A boy built a coal bin 15 ft. long, 10 ft. wide, and 6 ft. high. How many tons of soft coal will it hold if it can be filled to within $\frac{1}{2}$ foot of the top?

3. John saw a cylindrical silo whose height, he thought, was 36 ft. and whose diameter was 15 ft. Find the volume based on his estimates.

4. How much air space in a conical tent whose diameter is 18 ft. and whose height is 12 ft.?

5. This battery jar is 6 inches in diameter and 8 inches high. Dick thought it would hold a gallon. Was he too high or too low? How much?



6. The dimensions of these three bodies are equal. Their volumes are as 1:2:3. What does this mean?

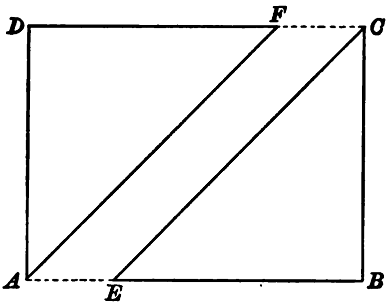
7. Jennie said, "I can place the sphere into the cylinder and then add one cone full of water." Was she right?

8. How many strokes must be made by a pump, having a cylinder 16 in. long and 4 in. in diameter, to throw a barrel of water ($31\frac{1}{2}$ gal.) if each stroke empties the full volume of the cylinder?

9. The rate of flow out of a two-inch artesian well is one foot per second. What is the flow in gallons in 24 hours if $7\frac{1}{2}$ gal. = 1 cu. ft.?

10. Find the convex surface of a cone whose altitude is 10 ft. and the diameter of whose base is 12 ft.

11. Find the area of a sector whose radius is 10 inches and whose arc is 10 inches.



12. The accompanying figure represents a garden in the form of a rectangle, 40 ft. long and 30 ft. wide, with a walk extending across it. The two gates, located at FC and AE respectively, are 6 ft. wide.

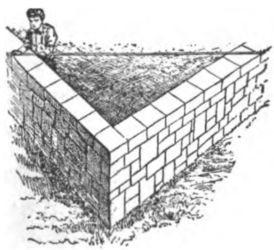
(1) Find the length CE; also the perimeter of the walk.

(2) What is the area of the walk?

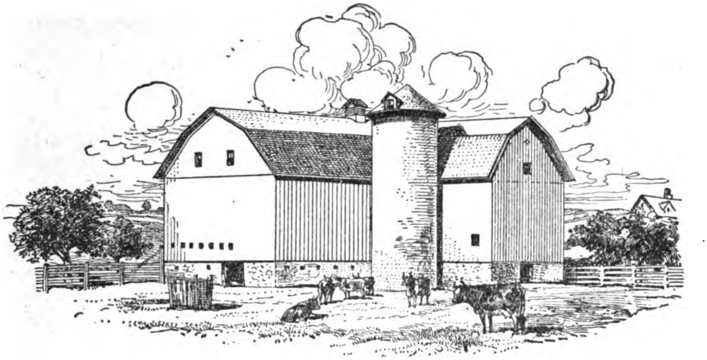
(3) What % of the entire figure is the area of the walk?

13. One side of an equilateral triangle is 12 ft. Find the altitude. Find the area.

14. The base of an isosceles triangle is 18, one of the equal sides is 15. Find the altitude and the area.



15. A contractor wished to know if the foundation of a building was square. He took a point 6 ft. from the corner on one wall and a point 8 ft. from the same corner on the other wall. What must have been the distance between these points if the foundation was square?



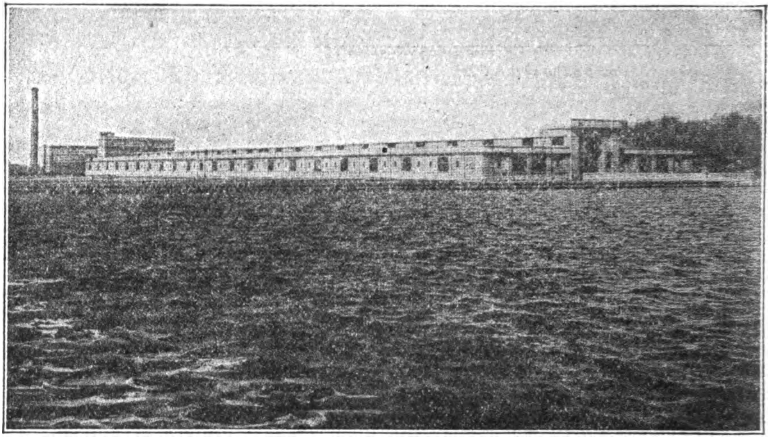
Silo Problems

1. A farmer built a cylindrical silo 10 feet in diameter and 20 feet high, inside measurements. If a cubic foot of silage (green corn fodder) weighs 36 pounds, how many tons are there in the silo when it is $\frac{3}{4}$ full?

2. A silo 32 ft. high and 16 ft. in diameter is full of silage. If 50 cu. ft. of silage weigh a ton, and a cow eats 30 lb. of it in a day, how long will this silage last 50 cows?

3. To keep silage in good condition a layer 2 inches deep should be used daily. A silo is 12 feet in diameter and is filled to such a depth that a cubic foot of silage weighs 35 pounds. How many cows should be kept to feed a layer 2 inches deep every day if each cow needs 34 pounds daily? Call π $\frac{22}{7}$.

4. The farmer who owns the silo in the previous problem wishes to keep enough cows to lower the silage in the silo 3 inches daily. How many must he keep?



A MODERN FILTERING PLANT AND SETTLING BASIN

In some villages each residence has its own well or cistern; in others there is a well at the public square or elsewhere for all the people; in others there is a large reservoir from which the water is piped to each home or business place. The last method is the one used by villages and cities with modern conveniences.

1. What is meant by modern conveniences?

2. State several reasons why the last method is most desirable?

Some cities are so situated that they must draw their water supply from a nearby stream or lake. This requires that the impurities be removed by settling or filtering, or by both, before the water is fit for use.

Name several impurities that should be removed.

1. A certain village in Ohio has in round numbers a population of 500. The reservoir for the town supply is a cylindrical tank 36 ft. long with a 9-foot diameter. What is the capacity of the reservoir? Count $7\frac{1}{2}$ gal. to the cu. ft.

2. The pump which supplies the tank in the first problem throws 2.7 gal. to the stroke and makes 23 strokes to the minute. How long, with steady pumping, will it require to fill the tank?

3. If the pump is driven on an average of 8 hours daily, how many gallons of water are allowed daily to each inhabitant in the village of problem one?

4. In a city whose population is 750,000, the cost of purifying its water in 1918 was $7.37 per million gallons. How much was that per gallon? At this rate how many gallons were purified for one cent?

5. In the same city the average daily consumption for 1917 was 104.3 million gallons. How much was that daily per person? How much was the total consumption for 1917? Express your answer in millions.

6. Using the data in 4 and 5, determine the average cost of purifying the water used by each person in a year.

7. St. Louis yearly purifies 36 billion gallons of water by adding 5.35 grains of lime, .68 grains of iron sulphate (copperas), and .58 grains aluminum sulphate (alum) to each gallon. How many tons of each of these materials are used yearly?

CHAPTER V

MONEY AND BANKING

Many of the problems which you have solved thus far have dealt with values expressed in dollars and cents, or, in other words, in monetary units. You will now have an opportunity to learn more about money itself and those things which represent money.

Money is a standard of value and a medium of exchange.

1. Name some materials which were used as money in the past.

2. A $10 gold piece is called an eagle. What is a double eagle? A half eagle? A quarter eagle?

3. The $10 gold piece weighs 258 grains. The other gold coins have a proportionate weight. Find the weight of a half eagle, of a double eagle.

4. Gold coins are 90% pure gold and 10% copper, which is called an alloy. How many grains of pure gold in each of our coins?

5. Name the silver coins.

6. The silver dollar weighs 412.5 grains. It is 90% pure silver and 10% copper. How many grains of silver in a silver dollar?

7. The nickel is 75% copper and 25% nickel. Why not call it a copper?

8. What is bullion?

9. How does the Government acquire the gold and silver which are coined into money?

10. Bar silver (bullion) sold in New York November 23, 1920, at $99\frac{1}{2}$¢ an ounce ($437\frac{1}{2}$ grains). What was the silver in a silver dollar worth on that day?

11. Consult the newspaper on the day you are studying this page for the price of silver and compute the value of the silver in a silver dollar.

12. What is the price of silver per ounce when the silver in a dollar is worth exactly 100¢?

13. The following were the prices of silver per ounce in New York City on the dates named: 11/10/'08, (Read Nov. 10, 1908), $49\frac{7}{8}$¢; 10/21/'12, $63\frac{1}{4}$¢; 10/17/'13, $61\frac{1}{4}$¢; 10/25/'15, $48\frac{7}{8}$¢; 10/25/'17, $82\frac{1}{2}$¢; 3/23/'18, $92\frac{7}{8}$¢; 10/20/'19, \$1.18$\frac{3}{4}$; 11/23/'20, $99\frac{1}{2}$¢.

Make a line graph showing the fluctuation (change in price) from 1908 to 1920.

14. What is a mint?

15. The letter *D* is found beneath the feet of the eagle on certain gold coins. What does *D* stand for?

16. Examine dimes, quarters, and other coins for the letter *D* or some other letter and tell what each represents.

17. Coins which have no letter on them are made in the Philadelphia mint.

18. Mills are not coined. They are used in computing, as in the problem, "Find the cost of 10 lb. of potatoes at \$.033 per lb."

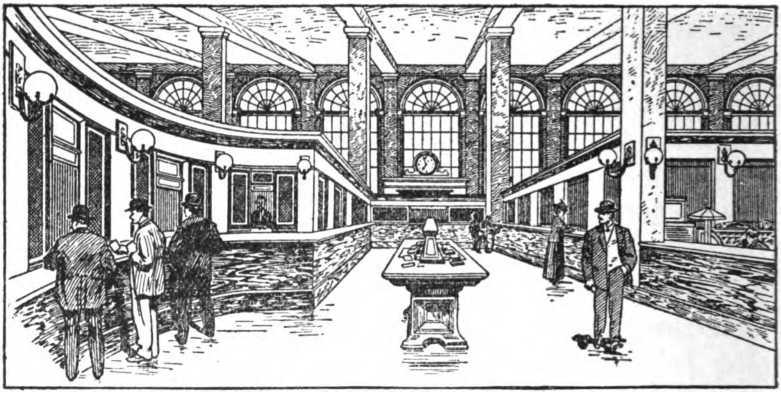
19. The paper money of a country is called its **currency.** What gives value to paper money?

20. Name the different kinds of paper money in common circulation in this country.

21. Read a United States note (greenback—our oldest paper money); then read a Federal Reserve note (our youngest paper money). How are the two alike? How are they different?

22. Read a silver certificate and, if possible, a gold certificate. How are they alike? How do they differ? Why does one not see much gold coin in circulation?

23. What is meant when we say, "A man's credit is good"?



24. How may a check which you sign pay several debts before the bank on which it is drawn marks it paid?

25. Is a check money? How does it accomplish the work of money?

26. Does a check represent money?

27. The total amount of money in the United States in 1919 was $7,662,893,238. The total bank deposits in round numbers in the same year were $22,000,000,000.

Banks and Banking

A bank is an institution which deals in money and credit. Banks receive money and credit for deposit; they loan money; they buy and sell notes; they make the transfer of credit easy. Some banks also issue money.

How to Open an Account

If you are a stranger to the bank, it is customary to require an introduction or some other form of identification. The banker gives you a signature card on which you must write your address and your name exactly as you wish to sign it on checks. The banker then gives you a **pass book** and a **check book.**

The Pass Book

This is a small book in which the bank writes your deposit and its date. It also contains a statement of the condition of your account at the time it is balanced. For this reason the pass book should be presented when a deposit is made and when you wish your account balanced.

Interest on Checking Accounts

Some banks allow a low rate of interest (2% or 3%) on the checking account whenever the daily balance is $500 or more. Other banks allow a low rate of interest on the daily balance. Some banks pay no interest on deposits. Other banks make a slight charge for keeping a small account.

How to Make a Deposit

Fill out a deposit slip (see form) containing your name, date, nature of items, whether coins, currency, or checks, and total. Hand this slip, the deposit, and your pass book to the banker. He verifies the amounts on the slip, places the total to your credit in the pass book, and returns it to you. In case you have forgotten your pass book, make two deposit slips exactly alike. The banker marks one "duplicate" and returns it to you. This duplicate should be presented for entry the next time you have the pass book with you.

Merchants National Bank

Cleveland, O.________192__

Deposited to the Credit of

____

	$	¢
Coins Currency Checks * List separately		
Total		

* Checks are received for collection.

How to Draw on Your Checking Account

Fill out properly a blank check. This check may be made payable to yourself, to cash, or to the order of some other person or firm to whom you wish to make a payment. A check should be made payable to cash when you draw the money in person. At the time of writing the check, fill out the stub to keep track of your account.

Balancing the Pass Book

For the convenience of the bank and for your own aid in verifying your figures on the stubs of your check book, you should leave your pass book at the bank every month. The bookkeeper then writes in it the total amount of your checks paid by the bank and the balance of your account. The canceled checks (paid checks) and the pass book are returned to you a short time later.

Indorsing Checks

Before you can pass an "or order" check (receive money or credit for it), you must indorse it. This may be done (1) by writing your name on the back of the left end of the check (blank endorsement), or (2) by writing, "pay to________or order," and your name (indorsement in full). See the forms on this page.

(1) Blank Indorsement	(2) Indorsement in Full
John Smith	*Pay to John Doe, or order.* *John Smith*

What Everyone Should Know about Checks

1. A check given in payment of a debt becomes a receipt.

2. A check should not be made to bearer. If lost or stolen, the finder or thief can collect it.

3. A check may be made to read "Pay to Cash." (Who can collect such a check?)

4. Signatures in lead pencil are good.

5. Checks should be presented for payment without unreasonable delay.

6. It is not permissible to overdraw one's account.

7. Partial payment can not be made on a check. It is either "all good or no good."

8. Checks dated on Sunday are good.

9. Checks postdated are charged to the proper account upon their arrival at the bank on which they are drawn. For this reason checks should not be postdated.

10. A postdated check is commonly treated by bankers as a demand promissory note.

11. Payment may be stopped on a check prior to its arrival at the bank on which it is drawn by notifying this bank by telephone, in person, or in writing.

12. A check indorsed in blank becomes a bearer check. What danger is there in such indorsement? When may such an indorsement be safely made?

13. When checks are deposited, they are usually credited as cash subject to collection. In such case what will the bank, receiving the check for deposit, do if the check is not good?

Problems

1. Make a deposit slip using the form shown on page 196.

2. Fill out the slip made in No. 1 in your name for the following items: two checks, one for $25.00 and the other for $18.75; one $20 bill; 3 five-dollar bills; 2 one-dollar bills; $10 in gold; 4 silver dollars; 5 half-dollars; 7 quarters; 15 dimes; 21 nickels; and 13 pennies.

3. Write a check for $7.50 drawn on your account in favor of John Domer.

4. Indorse in full the check drawn in No. 3.

5. Under what condition is it proper to indorse a check in blank?

6. When may one properly write a check "Pay to Cash"?

7. Why should a person not draw at once a check against a deposited check?

8. On the first of November Mr. Mann had a bank balance of $242.75. During the month he made the following deposits: Nov. 8, $45.90; Nov. 14, $162.80; Nov. 22, $296.40. During the month he issued checks for these amounts: $2.87, $52.60, $18.02, $15.42, $63.25, $14.22. What was his balance on December 1?

9. According to the figures given out by the Comptroller of the Currency the resources of the national banks of the United States in 1918 amounted to $19,821,404,000, which was a growth of $1,268,207,000 in a single year. What was the % of growth?

10. In 1918 there were 7754 national banks in this country. Only one of these banks failed during the year. What was the % of failure?

11. The total amount of deposits in the banks named in problem 10 was $15,051,000,000 in 1918. What were the average deposits per bank?

12. The following table shows the growth of American savings banks since 1820.

Growth of American Savings Banks

Year	Banks	Depositors	Deposits	Av. Due Each Depositor	Av. per Capita in U. S.
1820	10	8,635	$ 1,138,576	?	$ .12
1850	108	251,354	43,431,130	?	1.87
1870	517	1,630,846	549,874,358	?	14.26
1890	921	4,258,893	1,524,844,506	?	24.35
1900	1002	6,107,083	2,449,547,885	?	31.78
1910	1759	9,142,908	4,070,486,246	?	45.05
1918	1819	11,379,653	5,471,579,949	?	52.05

(1) Compute the value of each question mark.

(2) Construct a **line graph** showing the relative growth in the number of banks from 1820 to 1918.

(3) Construct **bar graphs** showing the growth in average per capita deposits.

(4) Find the population of the United States in 1918.

13. In 1919 there were 18,140,300 depositors in the national banks of the United States. The average per capita deposit in these banks was $878.87. Find the total deposits.

CHAPTER VI

TRADE AND TRANSPORTATION

The farmer cannot consume all the wheat and meat he can produce, neither can he produce profitably all the clothing he needs. The coal miner needs only a small portion of the coal he digs. He does not grow any of the wheat which he needs for bread.

Among civilized people it is a common thing for men to produce more of one commodity than they can consume and to need many things which they cannot produce. Meeting these needs of people and disposing of the surplus of the producer give rise to trade and transportation.

The business man buys the surplus and often sends it to another man whose business it is to get this surplus into the hands of those who need it.

1. Do you know any producers in your community who sell directly to consumers?

2. Do you know any business men who buy from producers and sell to consumers?

3. Do you know any business men who buy from other business men and sell to consumers?

4. Why must the consumer pay more to the business man than to the producer?

5. Write and solve a problem about a business man and a consumer in your community.

How Business Is Done

Before computing his profit the merchant adds to the cost of the goods the **expense of doing business.** This expense varies from 10% to $33\frac{1}{3}$% of the cost. Such items of expense as rent, tax, clerk hire, advertising, etc., are called **overhead charge, or overhead.**

Profit is the difference between what is actually received for an article and its **total cost,** also called **gross** cost. **Total cost = cost + transportation (freight, drayage, etc.) + overhead.** The last two addends are called the expense of doing business, or expense.

Business men often compute their rate of profit on the selling price.

Problems about Business

1. A merchant bought goods for $1800 and sold them for $2500. Find his profit if the expense of doing business was 25% of the cost. What was his rate of profit on the selling price?

2. A merchant bought men's shirts at $15 per dozen. His selling expense including overhead was $33\frac{1}{3}$% of the cost. He marked the shirts to sell at $2.50 each, but due to a slow season he actually received only an average price of $2.25. Find his rate of profit on the selling price.

3. A manufacturer sells his product at $10 per bbl. The cost of materials and of manufacturing amounts to $8 per bbl. The overhead is $12\frac{1}{2}$% of the selling price. Find the rate of profit on the total cost.*

* Rate of profit may be computed on the net cost, on the total cost, or on the selling price. Among business men there is no uniform practice on this point.

4. Construct and solve a problem about a grocery business in your community, using cost, overhead, selling price, and profit.

5. A dealer bought 30 bu. of apples at $1.25 per bu. and sold them at 40¢ a peck. At the same time he purchased 100 lb. of English walnuts at 15¢ a lb., which he retailed at 24¢ a lb. Which purchase was the more profitable in money and how much? Which yielded the greater rate of profit on the selling price?

6. A grocer buys peaches at $2.00 per dozen cans and sells them at 25¢ per can. It costs him 2¢ a can to sell them. Find the gross cost. What is his rate of profit on the selling price?

7. An Oklahoma grower of cantaloupes received $1.20 per crate. The crating cost 10¢ per crate; the express from Oklahoma to Denver, Colo., was 35¢ per crate. The consumer at Boulder (near Denver) paid $3.50 per crate for his cantaloupes. Who got the difference between $3.50 and the other items named above? How much is this difference? What % is it of what the farmer received?

8. An Ohio farmer in 1918 had 100 hens which laid during the year 809 dozen of eggs. These eggs were sold at an average of 43¢ per doz. He sold during the year poultry for which he received $38.70. What was the gross income per hen? How would you find the net income?

9. A broker bought for his firm goods for which he paid $1200. He received 3% brokerage. Freight and other delivery charges amounted to $20. Advertising cost $10. Find the selling price to gain 30% on the entire cost.

How Transportation Arises

Much trade and transportation arise also in the process of converting raw materials into the finished products and in getting these products into the consumer's hands. Cotton grown in the field is taken to the gin (what is done to it here?), then to the compress (what happens here?), then it is sent to the cotton mill (why?), then some of it goes to the shirt factory, and finally some of these shirts may be found in the home of the man who grew the cotton.

To get commodities from a region which can very abundantly produce them, to a region whose people want to buy them, because they can do other work with greater profit, requires some system of transportation, such as, good roads, railroads, or steamship lines.

Good Roads

Good roads may be built of dirt, gravel, macadam (crushed rock), brick, or concrete. Some good roads are

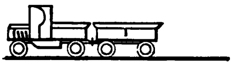


Fig. I Loose Gravel

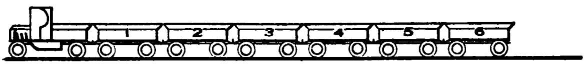


Fig. II Earth with Dust Top

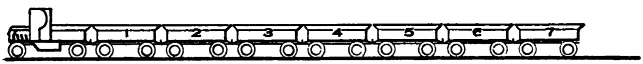


Fig. III Packed Gravel

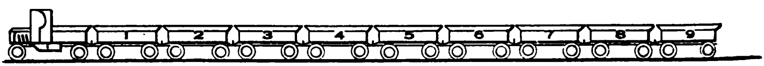
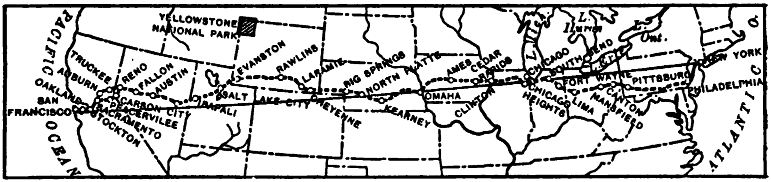


Fig. IV Waterbound Macadam

better than others. The load a given team, or tractor, can pull depends upon the grade, hardness, and surface of the road.

Assuming that each load in the previous figure has the same weight, compare the hauling advantage of II over I; of III over II; of IV over III; of IV over II.

An example of a good road is the Lincoln Highway from New York to San Francisco. Portions of this road have been built of brick, or of concrete. When this road is finished its entire length will be more than 3000 miles.



1. An Ohio farmer living on the Lincoln Highway can now haul 60 bu. of wheat on a load to market. Before this road was built he could haul only 40 bu. By working a little earlier and a little later, he can now haul three loads in a day instead of two. In 1919, his wheat crop was 600 bu. How much was the Lincoln Highway worth to him in marketing his wheat crop if he counted the labor of himself and team at $5 per day?

2. State other ways in which the Lincoln Highway benefits farmers living near it.

3. Who pays for building good roads?

Using Concrete

1. Concrete is a mixture of cement and sand; or of cement, sand, and gravel or crushed stone.

2. It is used in the construction of walks, roads, foundations, floors, walls, curbs, fence posts, trolley posts, water troughs, etc. How else have you seen concrete used?

3. Cement is bought by the sack, or by the barrel. A sack contains 1 cu. ft., and a barrel contains 4 cu. ft.

4. Sand, gravel, and crushed stone are bought by the cubic yard in many places. In large cities sand and gravel are commonly sold by the ton; crushed stone by the hundred cubic feet. A cu. yd. of sand or gravel weighs approximately 2700 lb.

5. Since concrete has various uses, the materials which go into it are mixed in different ratios. A rather common mixture is 1:2:3 (read one two three) for outside work. This means that for every cubic yard of concrete to be used a certain amount of cement (say 1.75 bbl.), 2 times as much sand, and 3 times as much gravel or stone are required. For foundations a 1:3:6 mixture may be used. What does this mean?

Concrete Table

Proportion of Volume of Material Used			Amount of Material in 1 cu. yd. of Concrete		
Cement	Sand	Stone or Gravel	Cement	Sand	Stone or Gravel
			bbl. cu. yd.	cu. yd.	cu. yd.
1	1		4.75 = .7	.7	
1	2		3.25 = .48	.96	
1	2	3	1.75 = ?	?	?
1	2	4	1.5 = ?	?	?
1	3	6	1. = ?	?	?

6. A cubic yard of space requires about 1.45 cu. yd. of material. In actual practice an additional 10% is allowed.

1. Find the value of all the question marks in the table.

2. Using the values found in the table determine the amount of each material required for 12 cu. yd. of concrete of a 1:2:3 mixture.*

3. How much of each material will be required for a top coat containing 8 cu. yd. of concrete of a 1:1 mixture?

4. How many cubic yards of materials will be required for a concrete base 6 inches thick in a basement 36 ft. × 25 ft.?

HINT.—Use a 1:2:3 mixture.

5. A walk 60 ft. long and 3 ft. wide is to be built with a concrete base (bottom) 5 inches thick of a 1:2:3 mixture, and a top coat 2 in. thick of a 1:1 mixture. How much of each kind of material is required if 10% is allowed for waste? Find the cost of the materials needed for this walk, using current prices.

6. If cement costs 75¢ a sack, sand $2.50 a cu. yd., and crushed stone $2.16 a cu. yd., find the cost of the materials in a 1:2:3 mixture sufficient to make 200 cu. yd. of concrete.

7. The foundation wall for a building 120 ft. long and 80 ft. wide, outside measurements, is to be 3 ft. wide and 9 ft. high. The concrete is to be a 1:3:6 mixture. Find the cost of the materials if the cement is worth 75¢ a sack, and if the sand and gravel are each worth $2.70 a load (1 cu. yd.), (1919 St. Louis price). Add 10% to each kind of material for waste.

* NOTE.—Any part of a sack or bbl. of cement, or of a cu. yd. of sand or stone, should be considered a full sack, bbl., or cu. yd.

Railroads

In 1917 there were in this country 253,000 miles of railroad, representing an investment of over $17,000,000,000. Even this large mileage was not enough to meet actual needs in 1917 and 1918.

1. What was the average investment per mile?

2. It is 3190 miles from New York to San Francisco. How many tracks between these cities would our railroad mileage make?

3. The total length of the railroads of the world in 1917 was 729,800 mi. The United States had 253,000 mi. What % of the world's railway mileage was that of the United States?

Methods of Shipping Goods

Merchandise may be shipped by freight, by express, or by parcel post.

1. When is shipment by parcel post preferable? Do you know the maximum weight which can be shipped by parcel post? If not, see page 214.

2. Would you ship watermelons from Texas to Chicago by freight or by express? Why?

3. Would you ship coal from the Illinois mines to Chicago by freight or by express? Why?

4. The freight charge on a car of tomatoes containing 500 crates, shipped from Miami, Fla., to Chicago, was $237.56. The cost of refrigeration was $80 and the drayage charge was 3¢ per crate. Find the total transportation cost per crate

5. Find the freight charge at 45¢ per 100 lb. on a car load of books weighing 39,200 lb., shipped from Chicago, Ill., to Louisville, Ky.

6. What was the freight rate per 100 lb. when $14.04 was paid on a shipment weighing 520 lb.?

7. The freight rate, first class, from Chicago, Ill., to Oklahoma City, Okla., was $\$1.87\frac{1}{2}$. Find the freight on a shipment of 3520 lb.

8. What is the total freight on four shipments of books whose weights and rate per 100 lb. are as follows: 220 lb. @ $\$3.31\frac{1}{2}$, 200 lb. @ $\$2.67\frac{1}{2}$, 340 lb. @ 72¢, 1060 lb. @ $\$1.19\frac{1}{2}$?

9. In 1919 a rate of $35 per ton of 2240 lb. was made for shipping wheat from Buenos Aires to New York City. How much was that per bushel?

10. In 1919 the Argentine Government fixed the minimum price for export wheat at $1.55 per bushel. At this rate, what did a bushel of Argentine wheat cost in New York if there was no import duty?

11. Can the farmers of our country compete with Argentine wheat growers without an import duty, as long as Argentine maintains an export price of $1.55 per bushel, and the shipping charge is $35 per ton of 2240 lb.?

12. The freight rate on wheat from Buenos Aires to Liverpool, in 1919, was 34¢ per bushel. The British Government in the same year fixed the sale price of imported wheat at $2.40 per bushel. Which was more profitable to the Argentine exporter, to have sold his wheat in New York, at $2.48, or in Liverpool at $2.40? How much?

13. Does the American wheat grower profit by the conditions described in problems 10, 11, and 12? Why?

14. A Chicago firm had a shipment of books weighing 22400 lb. for Louisville, Ky. The minimum car load is 24000 lb. The car load rate per 100 lb. was 45¢; the rate per 100 lb. in less than car load lots was $66\frac{1}{2}$¢. Which is better for the firm, to pay for a full car load, or to ship at the L. C. L. (less than car load) rate? How much better?

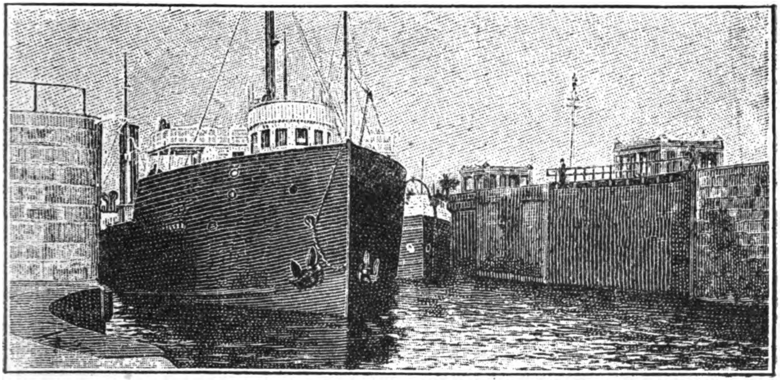
15. A Texas planter in 1919 grew 40 bales of cotton (500 lb. to a bale) for which he received $34\frac{1}{2}$¢ a lb. at Houston. The selling and handling charge at Houston was $1.00 per bale. The freight rate from his shipping point was 20¢ per 100 lb. How much did he get for his cotton crop after paying the freight and charges at Houston?

Advantages of Water Transportation

1. In a recent year 100,000,000 bu. of wheat were carried by steamer from Duluth, Minn., to Buffalo, N. Y., at a cost of 2¢ per bu. The freight by rail between these points was 5¢ per bu. What was the saving in freight on these shipments?

2. It costs $2.50 per thousand feet to move lumber from northern Michigan and Wisconsin to Buffalo by boat. To ship the same distance by train costs $5 per thousand feet. If 1,500,000,000 board feet are shipped each year between the points named, what is the saving in freight?

3. In a recent year 100,000,000 tons of freight were carried over the Great Lakes. How many car loads would this make if 20 tons were allowed to each car?



4. The largest inland canal locks in the world are between Lake Superior and St. Mary's River below the rapids. One of these is called the Poe Lock. It is 800 ft. long, 100 ft. wide, and 22 ft. deep. How many boats are handled by this lock during the season of navigation (8 months) if it averages one boat every 14 minutes day and night for the season. (Omit December, January, February, March.)

5. On a map of the United States and Canada, using Buffalo as a center, and a radius representing 500 miles, draw a circle. This circle contains 60% of the population of the United States and Canada. Name at least 12 great commercial centers within this circle. Show how the Great Lakes have been an important factor in building these great cities.

6. Will the shipping on the Great Lakes in the near future become greater, or less, than it is at present? Why?

7. When the L. C. L. rate on a certain commodity from New York to Chicago was $.63 by rail and water, or $.788 by all rail, the rate from Chicago by rail to Portland, Oregon, was $2.00. The same commodity could have been shipped from New York to Portland by an all water route at $1.25 per 100 lb. What was the comparative cost of shipping by the three routes?

Schedule of Express Rates from Chicago by Scale Numbers

(First Class in Effect Jan., 1920)

	Scale Numbers							
Pounds	13	16	18	23	28	43	124	179
1	$0.29	$0.29	$0.29	$0.29	$0.30	$0.30	$0.34	$0.37
2	.30	.30	.30	.31	.31	.33	.42	.47
5	.32	.33	.34	.35	.36	.41	.63	.78
10	.37	.38	.40	.43	.45	.54	.98	1.29
15	.42	.45	.46	.51	.55	.67	1.34	1.79
20	.47	.51	.53	.58	.64	.80	1.69	2.30
25	.52	.56	.59	.66	.73	.93	2.05	2.80
50	.77	.85	.90	1.04	1.18	1.59	3.82	5.33
100	1.26	1.43	1.54	1.81	2.09	2.91	7.37	10.39

Shipping by Express

Commodities shipped by express go more quickly, but at a higher rate, than those shipped by freight. Express charges include free delivery within certain limits. Such shipments are classified as first, second, or third class. The rate on a given commodity varies with the weight of the shipment, and with the distance between the shipping points. The rates charged are determined by the Interstate Commerce Commission.

This commission divided the United States into 826 blocks made by the intersections of the meridians of longitude and

the parallels of latitude. To determine the rate between any block and any other, the agent at the shipping point first refers to a *Directory of Express Stations*, issued jointly by the principal express companies, to find the block number of the destination office, and the scale of rates which applies between his block and the block to which he is shipping. There are 295 different scales in use, each designated by a number.

The agent then refers to his *Schedule of Express Rates by Scale Numbers* and finds what rate applies to the package shipped. This schedule shows rates on packages, weighing from 1 lb. to 100 lb., for each of the 295 scale numbers. The table on page 212 gives a few of these rates for eight of these scale numbers on first class matter. Packages over 100 lb. take the 100 lb. rate.

Some cities to which the scale numbers in the previous table apply on packages expressed out of Chicago.

Fort Wayne, Ind. Milford, Ind.	Scale 13	Nashville, Tenn. Springfield, Tenn.	Scale 28
Madison, Wis. Prairie du Sac, Wis.	Scale 16	Boston, Mass. Haverhill, Mass.	Scale 43
Louisville, Ky. Carrollton, Ky.	Scale 18	Helena, Mont. Boulder, Mont.	Scale 124
Columbus, Ohio Chillicothe, Ohio	Scale 23	San Francisco, Cal. Fruitvale, Cal.	Scale 179

1. A Chicago firm shipped the following first class packages by prepaid express in one day:

10 lb. to Ft. Wayne, Ind.	25 lb. to Nashville, Tenn.
2 lb. to San Francisco, Cal.	15 lb. to Columbus, Ohio.
50 lb. to Louisville, Ky.	10 lb. to Boston, Mass.
5 lb. to Helena, Mont.	120 lb. to Madison, Wis.

With the help of the table find the express charge on each package; on all the packages.

2. Find the total express charges out of Chicago on these packages: 10 lb. to Fruitvale, Cal.; 100 lb. to Chillicothe, Ohio; 50 lb. to Milford, Ind.

3. On a certain day in April, 1920, a Chicago firm sent packages of books by express as follows: 50 lb. to Haverhill, Mass.; 20 lb. to Boulder, Mont.; 100 lb. to Columbus, Ohio; 15 lb. to Prairie du Sac, Wis.; 20 lb. to Nashville, Tenn.; 25 lb. to Louisville, Ky.; and 1 lb. to San Francisco. Find the total express charges for the day.

Shipping by Parcel Post

The parcel post law in effect Dec., 1920, provides that packages weighing more than 4 ounces may be sent through the post-office department, at rates which vary for the different distances of transportation. See the table.

The limit of weight for the local zone and the next three is 70 lb.; for all other zones the limit is 50 lb.

A fraction of a pound is counted 1 lb. Parcels weighing 4 oz. or less go at 1c an ounce without regard to distance.

Table showing rates for all the zones on weights to 6 lb.

		To 50 mi.	50 mi. to 150 mi.	150 mi. to 300 mi.	300 mi. to 600 mi.	600 mi. to 1000 mi.	1000 mi. to 1400 mi.	1400 mi. to 1800 mi.	1800 mi. and over
Wt.	Local	1st	2nd	3rd	4th	5th	6th	7th	8th
1 lb.	$0.05	$0.05	$0.05	$0.06	$0.07	$0.08	$0.09	$0.11	$0.12
2 lb.	.06	.06	.06	.08	.11	.14	.17	.21	.24
3 lb.	.06	.07	.07	.10	.15	.20	.25	.31	.36
4 lb.	.07	.08	.08	.12	.19	.26	.33	.41	.48
5 lb.	.07	.09	.09	.14	.23	.32	.41	.51	.60
6 lb.	.08	.10	.10	.16	.27	.38	.49	.61	.72

The rate of increase shown in the table holds until the largest weight for each zone is reached.

The following formulas are useful in computing the parcel postage. Test the accuracy of each with the table.

Zone No.	Postage	Zone No.	Postage
Local	$\frac{\text{Wt.}}{2} + 5 = \text{no.}¢$	1 and 2.	$\text{Wt.} + 4 = \text{no.}¢$
3.	$\text{Wt.} \times 2 + 4 = \text{no.}¢$	4.	$\text{Wt.} \times 4 + 3 = \text{no.}¢$
5.	$\text{Wt.} \times 6 + 2 = \text{no.}¢$	6.	$\text{Wt.} \times 8 + 1 = \text{no.}¢$
7.	$\text{Wt.} \times 10 + 1 = \text{no.}¢$	8.	$\text{Wt.} \times 12 = \text{no.}¢$

1. The distance from Chicago to Pittsburgh is a little less than 500 mi. What is the postage on an 8 lb. parcel?

2. The distance from St. Louis to Chicago is 292 mi. Find the postage on a package weighing 20 lb.

3. From Chicago to Salt Lake City is 1489 mi. What is the postage on a 4 lb. parcel?

4. Using the formulas on this page, compute the postage on each of these parcel post packages.

Weight	Zone or Distance	Postage	Weight	Zone or Distance	Postage
1. 60 lb.	Local	?	6. 1 lb. 6 oz.	1350 mi.	?
2. 10 oz.	1200 mi.	?	7. 50 lb.	60 mi.	?
3. $1\frac{1}{2}$ lb.	2000 mi.	?	8. $12\frac{1}{2}$ lb.	First	?
4. 40 lb.	Third	?	9. 4 lb.	Sixth	?
5. $10\frac{1}{2}$ lb.	Second	?	10. $5\frac{3}{4}$ lb.	Fourth	?

Solve these with the help of the parcel post and express rates found on pages 212, 213, and 214.

1. Which is cheaper and how much, to send a 10 lb. package from Chicago to Columbus, Ohio, by express or by parcel post? Columbus is in the 4th zone from Chicago.

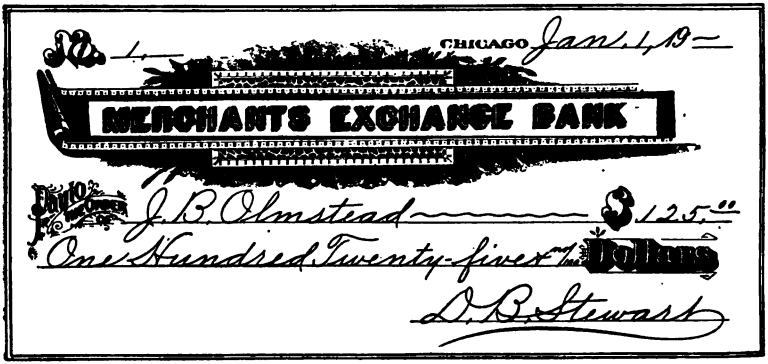
2. A Chicago firm wishes to send a 15 lb. package of books to Nashville, Tenn., distance about 450 mi. Which is cheaper, and how much, express or parcel post?

3. If the package described in problem 2 had weighed only 3 lb., which would have been the cheaper method of shipment? Which if it had weighed 10 lb.?

Paying Debts at a Distance

In the processes of trade, money or its equivalent must often be sent from one city to another. Instead of the money itself, a check, a draft, or a money order, may be used. Why is this better than to send the money?

1. D. B. Stewart of Chicago, Ill., bought for cash an invoice of goods amounting to $125 from J. B. Olmstead, Des Moines, Iowa. This is the check which he sent to Olmstead.


No. 4 CHICAGO Jan. 1, 19—
MERCHANTS EXCHANGE BANK
Pay to the Order of J. B. Olmstead $125.00
One Hundred Twenty-five & 00/100 Dollars
D. B. Stewart

(1) What will Olmstead do with the check?

(2) It is said that a canceled check is as good as a receipt. What is meant by this statement?

2. Some firms do not wish to accept personal checks. In such a case a money order (postal or express), or a bank draft (banker's check), may be sent.

Application for Domestic Money Order

Spaces below to be filled in by purchaser, or, if necessary, by another person for him

Amount

.... Dollars................ Cents

Pay to Order of } ....
(Name of person or firm for whom order is intended)

....

Whose Address is } No. ....Street

Post Office } ....

State ....

Sent by ....
(Name of Sender)

....

Address of Sender } No. ....Street

Purchaser must send Order and Coupon to Payee

Fees for Domestic Money Orders

Amt. of Order		Fee
$0.01 to	$2.50	3 cents
$2.51 to	$5.00	5 cents
$5.01 to	$10.00	8 cents
$10.01 to	$20.00	10 cents
$20.01 to	$30.00	12 cents
$30.01 to	$40.00	15 cents
$40.01 to	$50.00	18 cents
$50.01 to	$60.00	20 cents
$60.01 to	$75.00	25 cents
$75.01 to	$100.00	30 cents

NOTE.—The maximum amount for which a single money order may be issued is $100. When a larger sum is to be sent additional orders must be obtained. Any number of orders may be drawn on any money order office on any one day.

Roy Brown, Benton, Ohio, bought for cash a baseball glove from Spalding Bros., Cleveland, Ohio, for $2.00. He sent the money in the form of a postal money order.

1. Before the Benton postmaster issued the money order, Brown wrote an application on a form such as is shown here.

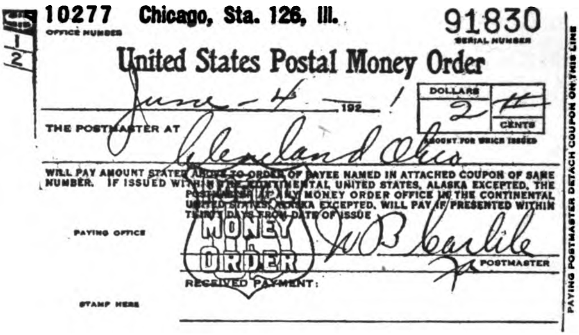
2. How much did he pay the postmaster?

3. What did Brown do with the order received from the postmaster? See page 218 for a form of money order and the receipt.

4. What should Brown do with the receipt? Of what value is it?

5. How did Spalding Bros. get the money for the glove?

6. Write in good form Brown's letter to Spalding Bros.

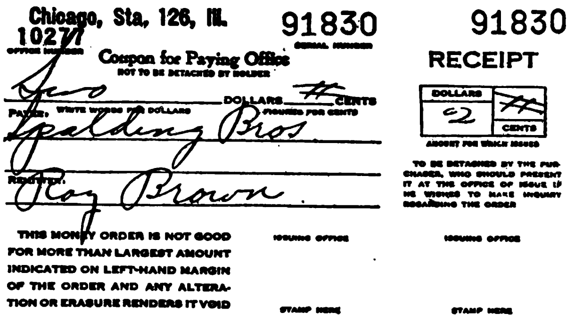


10277 Chicago, Sta. 126, Ill. 91830
OFFICE NUMBER SERIAL NUMBER
United States Postal Money Order
June 4 192 1
DOLLARS 2 CENTS
AMOUNT FOR WHICH ISSUED
THE POSTMASTER AT Cleveland Ohio
WILL PAY AMOUNT STATED ABOVE TO ORDER OF PAYEE NAMED IN ATTACHED COUPON OF SAME NUMBER. IF ISSUED WITHIN THE CONTINENTAL UNITED STATES, ALASKA EXCEPTED, THE POSTMASTER AT ANY MONEY ORDER OFFICE IN THE CONTINENTAL UNITED STATES, ALASKA EXCEPTED, WILL PAY IF PRESENTED WITHIN THIRTY DAYS FROM DATE OF ISSUE
PAYING OFFICE
MONEY ORDER
W. B. Carlile POSTMASTER
RECEIVED PAYMENT:
STAMP HERE
PAYING POSTMASTER DETACH COUPON ON THIS LINE

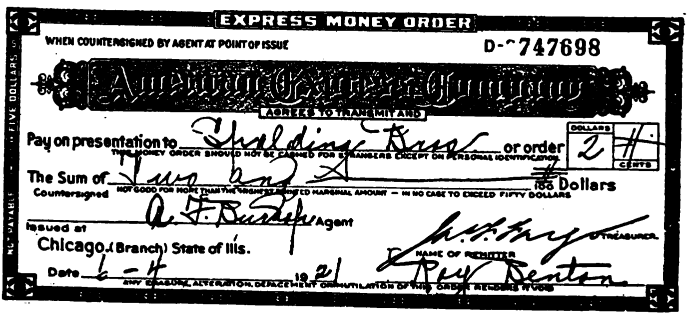
The purchaser must send both the order and the coupon to person named in the coupon as payee.

Express Money Orders

The fee for these orders is the same as that for postal money orders. No single order will be issued for more than $50. The number of indorsements is not limited to one.



Chicago, Sta. 126, Ill. 91830 91830
10277
OFFICE NUMBER SERIAL NUMBER
Coupon for Paying Office
NOT TO BE DETACHED BY HOLDER
Two DOLLARS CENTS
WRITE WORDS FOR DOLLARS FIGURES FOR CENTS
PAYEE: Spalding Bros
REMITTER: Roy Brown
THIS MONEY ORDER IS NOT GOOD FOR MORE THAN LARGEST AMOUNT INDICATED ON LEFT-HAND MARGIN OF THE ORDER AND ANY ALTERATION OR ERASURE RENDERS IT VOID
ISSUING OFFICE
STAMP HERE
RECEIPT
DOLLARS 2 CENTS
AMOUNT FOR WHICH ISSUED
TO BE DETACHED BY THE PURCHASER, WHO SHOULD PRESENT IT AT THE OFFICE OF ISSUE IF HE WISHES TO MAKE INQUIRY REGARDING THE ORDER
ISSUING OFFICE
STAMP HERE



EXPRESS MONEY ORDER
WHEN COUNTERSIGNED BY AGENT AT POINT OF ISSUE D-747698
American Express Company
AGREES TO TRANSMIT AND
Pay on presentation to Spalding Bros or order
DOLLARS 2 CENTS
THIS MONEY SHOULD NOT BE CASHED FOR STRANGERS EXCEPT ON PERSONAL IDENTIFICATION
The Sum of Two and $\frac{00}{100}$ Dollars
Countersigned NOT GOOD FOR MORE THAN THE HIGHEST PRINTED MARGINAL AMOUNT — IN NO CASE TO EXCEED FIFTY DOLLARS
A. F. Burke Agent
Issued at Chicago (Branch) State of Ills.
Date 6-4 1921
TREASURER
NAME OF REMITTER Roy Benton
ANY ERASURE, ALTERATION, DEFACEMENT OR MUTILATION OF THIS ORDER RENDERS IT VOID
FIVE DOLLARS
NOT PAYABLE

Business men find it more economical to remit by **bank draft** than by money order, if they cannot send their personal check without adding an extra 15¢ or 25¢ for exchange.

A draft is an order by one bank on another bank to pay a certain sum of money to a party named in the draft.

The Farmers' and Merchants' Bank

Millersburg, Ohio, *July 1, 1920.*

Pay to the Order of *John Gibbs* *$125.00*

One Hundred Twenty-five Dollars

To *Central National Bank,* *Louis Miley*

Cleveland, Ohio Cashier

BANK DRAFT

John Gibbs is a farmer near Millersburg, Ohio, who owes the Cleveland Milling Co. a bill for mill feed, amounting to $125. Since he has an account with the Millersburg bank, he is not charged a fee for drafts which he may wish to buy at this bank.

1. Of what bank is Louis Miley cashier?

2. Who is ordered to pay $125? Who pays $125 to the Millersburg bank?

3. Why can the Millersburg bank order the Cleveland bank to pay $125?

4. To whom is this draft payable?

5. What must Gibbs do before sending the draft to the Cleveland Milling Co.?

Commercial Drafts

A **commercial draft** is a written request directing a person or firm to pay to a bank, or person, a certain sum of money at a stated time.

Adam Miller of Mt. Liberty, O., owes Brown & Co. of Columbus, O., $140 on account. If Miller is not prompt in paying the account when it is due, Brown & Co. may draw on him, using the following commercial draft.

$140.00	Columbus, Ohio, *Dec. 15, 1920*
At Sight Pay to the order of the *New First National Bank*	
One Hundred Forty~~~~~~~~~~~~ Dollars	
Value Received and Charge to the Account of	
To *Adam Miller,*	
Mt. Liberty, O.	*Brown & Co.*

Brown & Co. deposit this draft with their bank (New First National) for collection. After endorsing it this bank sends the draft to a bank at Mt. Liberty, which presents it to Miller for *acceptance.* If he accepts the draft by writing the word "Accepted," the date, and his signature across the face of it, the draft is good, and being a sight draft it becomes due at once. Miller may give his check for $140 in favor of the Mt. Liberty bank. This bank in turn remits to the Columbus bank, which places the amount, less a small fee for collection (usually ¼%), to the credit of Brown & Co.

Sight drafts are due when they are accepted.

Time drafts are due a stated number of days after date or after acceptance. The draft must state definitely when

payment is to be made. The draft on this page is due 60 days after it is accepted.

$3170.45	NEW YORK, N. Y., *Mar. 16, 1919.*
At sixty days sight PAY TO THE ORDER OF	
Chas. G. Price	
Thirty-one Hundred Seventy cnd 45/100 DOLLARS	
VALUE RECEIVED AND CHARGE TO ACCOUNT OF	
To *Mabley-Carew Co., Cincinnati, Ohio.*	*Chas. G. Price*

Problems

1. The draft on page 220 was accepted on Dec. 17. Copy it and write the proper acceptance across the face.

2. Write the draft on this page. Accept it on Mar. 24.

3. When is the draft in example 2 due? Who pays it? To whom?

4. Write a commercial time draft due in ten days after sight, in which Brown & Co. draw on Frank Smith of New London, O.

5. Sidney Brown of Madison, Ind., owes Lyons and Carnahan of Chicago, Ill., $60 due Oct. 1, 1920. Write the proper commercial sight draft. Who signs this draft? Trace the draft until Lyons and Carnahan are credited with $60, less 10¢ for collection.

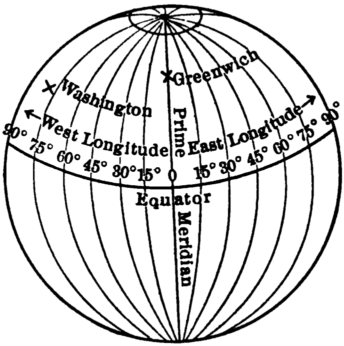
CHAPTER VII

TRAVEL

How Time Changes When We Travel

When Jack's father returned from New York City to his home at Cincinnati, he told Jack that the clocks in New York were one hour faster than those of Cincinnati. The following pages tell how Jack learned why different places may have different time at the same moment.

Longitude and Time



1. How long does it take the earth to make one rotation? How far in degrees does a given point on the earth rotate in 1 hr.? How far in 1 min.?

2. In what direction does the earth rotate?

3. Any place is said to have noon (12 o'clock, sun time) when the sun is on the meridian of that place. In what direction does the shadow point at noon in the United States?

4. When it is noon at Cincinnati, O., what is the time of all places on the same meridian as that of Cincinnati? What is the time for all places east of Cincinnati? Why? For all places west of Cincinnati? Why?

5. When it is 12 o'clock at Cincinnati, what is the time of all places 15° east of this city? Of all places 15° west of this city? Why?

6. When it is 12 o'clock by the sun at your town, what places have 10 A.M.? What places have 2 P.M.? Why?

7. When it is 6 A.M. at Chicago, how far in degrees and in what direction must you go to find a place whose time is 5 A.M.? Why? How far to a place whose time is 8 A.M.?

8. When it is 9 A.M. at St. Paul, what is the time of a place 45° east of St. Paul? Of a place 45° west of St. Paul?

9. If you know the difference in time between two places, how can you find the difference in longitude?

10. If you know the difference in longitude between two places, how do you find the difference in time?

11. If you know the difference of time between two places, their direction (east or west) from each other, and the time of one, how do you find the time of the other?

12. If you eat breakfast at 7 A.M., in what direction and how many degrees away from you would people be eating lunch at 12 o'clock noon at your breakfast time?

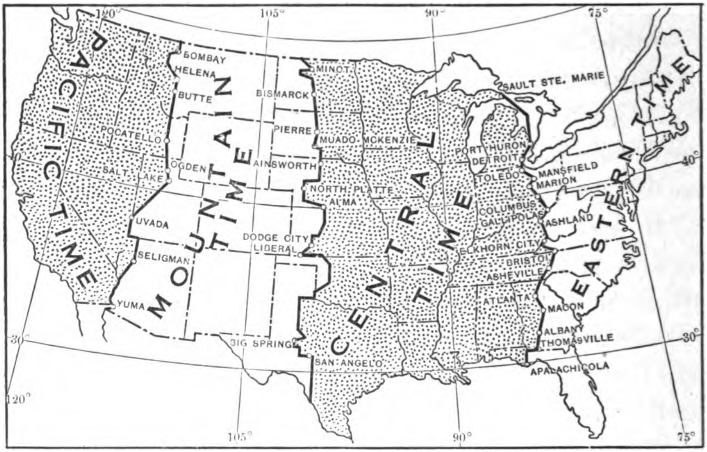
13. Where would people be eating supper at 6 P.M. at the moment San Francisco children begin school at 9 A.M.?

14. Events occurring at 9 A.M. in London, Eng., may appear in the Chicago morning papers in time to be read at a 7 o'clock breakfast. How is this possible?

Standard or Railroad Time

You have observed that solar or sun time changes as one travels east or west. To avoid confusion caused by this fact,

the railroads of our country in 1883 adopted a plan of giving all places within a given belt the same time, called standard or railroad time. In accordance with this plan the United States was divided into four great divisions, called Eastern, Central, Mountain, and Pacific time belts.



STANDARD TIME BELTS

Eastern time is the solar (also called local) time of the 75th meridian; Central time is the solar time of the 90th meridian; Mountain time is the solar time of the 105th meridian; and Pacific time is the solar time of the 120th meridian. It follows then that the standard time of all places in a given belt differs by one hour from the standard time of places in the adjoining belt or belts because the governing meridians are 15° apart.

Since Jan. 1, 1919, standard Eastern Time has been used by railroads from the Atlantic Ocean west to a line through Sault Ste. Marie, Mich.; Toledo, Ohio; Ashland, Ky.; Atlanta, Ga.; to Apalachicola, Fla. See the map.

What is the western boundary of the Central Time belt? Of the Mountain Time belt? See the map.

The lines marking the boundaries of time belts are not meridians. They are irregular north and south lines connecting stations (usually division points) on important railroads.

Problems about Standard and Solar (Local) Time

Use the map and your knowledge of longitude and time to help you solve these problems.

1. In which time belt do you live? Is your local time faster or slower than your standard time?

2. What is the difference between Central time and the local time of places on the 90th meridian?

3. Frank said, "My local time is 20 min. faster than Central time." What was his longitude?

4. James said, "Central time is 20 min. slower than my local time." What was his longitude?

5. If the boys mentioned in problems 3 and 4 live in places 100 miles apart, what must be the direction of each from the other?

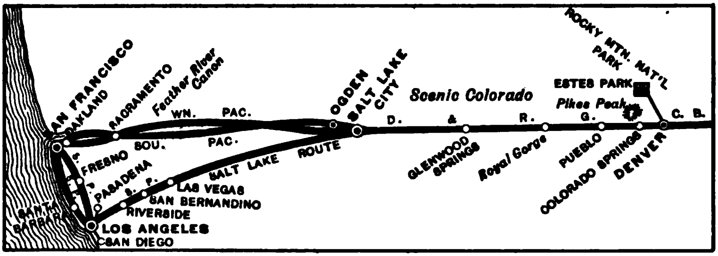
6. Mary said, "My local time is the same as Eastern time." Where does she live?

7. When it is 9 A.M. standard time at Denver, what is the standard time at New York City?

8. When it is 1 P.M. standard time at Boston, what is the standard time at Portland, Ore.?

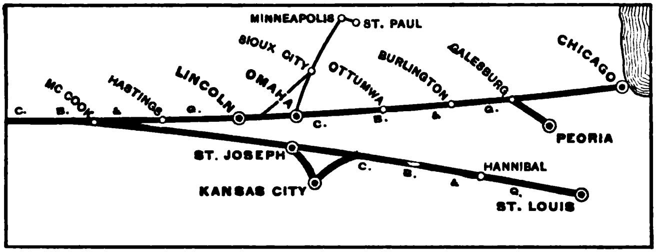
9. If you know your longitude in degrees and minutes, how can you compute the difference between your local and your standard time?

10. Does Chicago have noon (sun time) before or after Memphis, Tenn.? Why?



		READ DOWN		FROM AND TO CHICAGO		READ UP			
		No. 3 Daily (One day for example)		Miles from Chgo.	Burlington Route	No. 2 Daily (One day for example)			
		11.00	M	....	Lv.........Chicago.........Ar	7.00	F		
		3.53	Tu	163	...........Galesburg...........	2.50	F		
		5.20	Tu	206	..........Burlington...........	1.24	F		
		7.37	Tu	280	..........Ottumwa...........	**11.15**	Th		
		4.25	Tu	496	............Omaha..........Ar	**3.30**	Th		
		6.10	Tu	551	............Lincoln.........Ar	**1.20**	Th		
		8.30 7.30	W W	1034	Cent. Time Cent. Time Ar.........Denver.........Lv Mt. Time Mt. Time	**10.45** **9.45**	W W		
No. 1		No. 3			D. & R. G. R. R.	No. 2		No. 4	
8.15	W	**3.55**	W	1034	Lv.........Denver..........Ar	**8.20**	W	**12.45**	Th
10.57	W	**6.37**	W	1109	........Colorado Springs........	**5.52**	W	10.10	Th
12.20	W	**8.10**	W	1153	.............Pueblo...........	**4.25**	W	8.45	Th
12.25	Th	**9.00**	Th	1780	Ar......Salt Lake City......Lv	**4.45**	Tu	8.15	W
1.40 **12.40**	Th Th	**10.25** **9.25**	Th Th	1817	Mt. Time Mt. Time Ar..........Ogden..........Lv Pac. Time Pac. Time	**3.20** **2.20**	Tu Tu	6.45 5.45	W W
		No. 5			Southern Pacific	No. 2			
		11.30	Th	1817	Lv.Pac.Time Ogden............	**12.05**	Tu		
		5.10	Sa	2510	Ar........Sacramento..........	**2.35**	M		
		9.10	Sa	2599	Ar.......San Francisco......Lv	11.00	M		
No. 1		No. 3			Western Pacific	No. 2		No. 4	
11.40 10.40	Th Th	**10.00** **9.00**	Th Th	1780	Mt. Time Mt. Time Lv......Salt Lake City......Ar Pac. Time Pac. Time	**3.30** **2.30**	Tu Tu	5.30 4.30	W W
12.40	F	2.30	Sa	2569	..........Sacramento..........	**2.00**	M	12.20	Tu
5.45	F	7.45	Sa	2707	.........San Francisco......Lv	9.15	M	**7.15**	M
No. 7		No. 3			Salt Lake Route	No. 8		No. 4	
1.40 **12.40**	Th Th	**11.55** **10.55**	Th Th	1780	Mt. Time Mt. Time Lv......Salt Lake City......Ar Pac. Time Pac. Time	**12.35** **11.35**	Tu Tu	6.00 5.00	W W
1.30	F	7.00	Sa	2564	Ar........Los Angeles.......Lv	10.50	M	**8.00**	M

NOTE.—Bold face type is P. M. Light face is A. M.



READ DOWN		FROM AND TO ST. LOUIS		READ UP	
No. 17 Daily (One day for example)		Miles from St. Louis	Burlington Route	No. 16 Daily (One day for example)	
9.01	M	0	Lv.........St. Louis.........Ar	7.19	F
12.06	Tu	120	Lv.........Hannibal.........Ar	3.45	F
3.20	Tu	224	Lv........Brookfield........Ar	12.35	F
9.50	Tu	348	Lv.......Kansas City.......Ar	8.45	Th
11.59	Tu	326	Lv........St. Joseph........Ar	6.10	Th
1.30	W	674	Lv.........McCook.........Ar	5.00	Th
9.00	W	928	Cent. Time Cent. Time Ar..........Denver..........Lv Mt. Time Mt. Time	9.40	W
8.00	W			8.40	W

Problems about Travel

The problems in this exercise are based on the railroad map and time tables shown on pages 226 and 227.

1. How many hours and minutes is the run according to the table from Chicago to Denver? From St. Louis to Denver? From Denver to Salt Lake? From Salt Lake to Los Angeles? From Ogden to San Francisco?

2. What is the distance from Chicago to Los Angeles? From St. Louis to Los Angeles? From Chicago to San Francisco?

3. John leaves Chicago Monday at 11 P.M. When will he arrive at Salt Lake City? When will he arrive at Los Angeles?

4. What change in time is made at Denver? At Salt Lake City? At Ogden? Does the table show the actual number of hours traveled between Chicago and Los Angeles?

5. A person leaving St. Louis at 9:01 P.M. for San Francisco wishes to go by the quickest route. Which is it, the Western Pacific out of Salt Lake City or the Southern Pacific out of Ogden? How many hours will be saved by selecting the right route?

6. How often and in which cities is the time changed in traveling from Chicago to San Francisco? From Chicago to Los Angeles?

7. Excursion tickets from St. Louis to Denver and return have been sold at $25 each. At this price what was the fare per mile?

8. If a tourist leaves Chicago at 11 P.M. on Saturday, when should he arrive at San Francisco if there is no delay?

9. If you should leave Chicago on Saturday for Los Angeles and should spend a day at Denver, one at Colorado Springs, and should leave Salt Lake City on No. 7 (see the time tables), when would you arrive at Los Angeles? Why should one want to stop at these points?

10. Estimating the railroad fare at 3¢ per mi. and the Pullman fare at $23 for a lower berth, find the cost of a full fare railroad and Pullman ticket from Los Angeles to Chicago if there is an 8% war tax on railroad and Pullman transportation.

11. The Pullman fare for an upper berth is 80% of that of a lower. What would have been the total fare from Chicago to Los Angeles if you had paid for an upper? How

much can a person save between Chicago and Los Angeles by buying an upper instead of a lower berth?

12. Make other problems based on pages 226 and 227, and after solving them yourself give them to a classmate for solution.

13. A man paid \$5.54 for a railroad ticket between two towns. The war tax was 8%. What was the fare itself? At 3 cents a mile, what was the distance?

14. I paid \$20.28 for railroad and Pullman tickets between two cities. The regular Pullman ticket I knew was \$3.00 and the railroad fare was 3 cents per mile. The war tax was 8% on railroad fares and 8% on Pullman tickets. What was the railroad fare and the distance?

15. In Jan. 1921, I paid \$15.29 for railroad and Pullman tickets from Chicago to St. Louis. The regular Pullman ticket I knew was \$3.75, and the railroad rate was 3.6¢ per mile. The war tax was 8% each on Pullman and on railroad tickets. What was the railroad fare and the distance?

16. Plan the route and determine the probable cost of a round trip to your state capital from your nearest railway station. Plan to spend one day at the capital. Why should young people want to visit their state capital?

17. Plan the route, the traveling time, and the probable cost of a round trip from your town to Washington, D.C. Mention some points of interest bearing on your school studies, which might make such a trip valuable to boys and girls.

18. In January, 1919, Eric Springer flew a plane from Dayton, Ohio, to Cleveland, Ohio, distance 215 miles in 75

minutes. How many miles per hour was that? Compare his rate of travel with that of a fast passenger train.

19. On Feb. 6, 1919, the pilot mentioned in problem 18 flew from Cleveland, O., to Washington, D.C., in a non-stop flight in 2 hours 58 minutes, distance 450 miles. Compare the average speed on this trip with that in problem 18.

20. On Feb. 21, 1919, Col. Walter G. Kilner flew in a DeHaviland machine from Riverside, Cal., to Rockwell Field, distance 115 miles, in 38 minutes. What was the average speed per hour?

21. In June, 1919, Capt. John Alcock and Lieut. Arthur Brown, two British officers, made the first non-stop trans-Atlantic flight. They flew from Newfoundland to Clifden, Ireland, in 16 hr. 12 min., distance 1960 mi. Compute their average hourly rate of travel.

HINT.—Think 16 hr. 12 min. as 16.2 hr.

22. Lieutenant Belvin Maynard drove an airplane in Oct. 1919, from Mineola, Long Island, to San Francisco, Cal., distance 2700 miles, in 24 hr. 59 min. 48½ sec. His closest competitor, Major Carl Spatz, made the same trip in 26 hr. 13 min. 14 sec.

(1) How much did Maynard lack of requiring 25 hours for his trip?

(2) How much did he beat Major Spatz?

(3) Compute the average speed per hour of each, calling the time of one 25 hours and that of the other 26 hr. 13 min.

CHAPTER VIII

ECONOMY AND THRIFT

This chapter contains problems intended to show how a knowledge of arithmetic enables one to practice economy and thrift, by helping to answer the question, "Will it pay?" or "Did it pay?" or "Which course of action is most economical?"

Thrift in the School

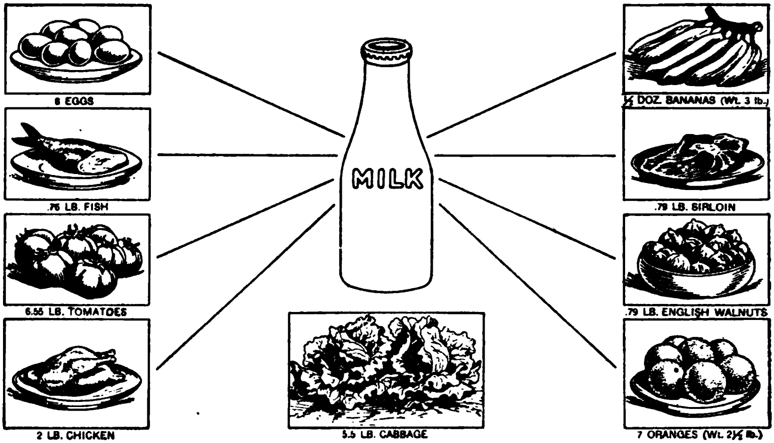
1. The children of the Mullanphy School collected in two months 11325 lb. of old newspapers and 2550 lb. of magazines. They received $1.25 per 100 lb. for the newspapers and $2.75 per 100 lb. for the magazines. What was the total received for old paper?

2. The children of the school named in the previous problem collected from Sept. 1, 1919, to Jan. 1, 1920, 17975 lb. of old magazines. What was the average amount received per month at the price named in the previous problem?

3. The children of the public schools of St. Louis during March and April, 1920, collected, weighed, and computed the value of 267450 lb. of old newspapers and 28514 lb. of old magazines. Newspapers were priced at $1.25 per 100 lb.; magazines at $2.75 per 100 lb. Find the total value.

4. If the children had not collected this old paper, what would probably have happened to most of it? Name several ways in which collecting and selling old paper promotes thrift?

Knowing Food Values



Each of the above amounts equals 1 qt. of milk in energy value.

Table of Jan., 1921, Prices

Milk . . .	16¢ a qt.	Tomatoes .	30¢ a lb.	Fish (halibut)	35¢ a lb.
Eggs . . .	75¢ a doz.	Bananas . .	8¢ a lb.	Sirloin steak	40¢ a lb.
Cabbage . .	4¢ a lb.	Oranges . .	60¢ a doz.	Eng. walnuts	28¢ a lb.

1. If you use the cost of a quart of milk as the basis, which is the cheaper food at the prices stated in the table; oranges or bananas? eggs or sirloin steak? English walnuts or fish? eggs or fish?

2. Which is the most expensive food? Which is the cheapest?

3. Calling the energy* value of 1 qt. of milk one, or 100%, find the % of energy value in 1 lb. of each of the other foods in the figure.

* Energy is ability to do work.

4. If eggs were 36¢ a dozen, what could you afford to pay for a quart of milk to get an equivalent energy value? What with oranges at 40¢ a dozen? What with bananas at 5¢ a lb.? What with cabbage at 2¢ a lb.? What with sirloin steak at 35¢ a lb.?

5. Make and solve other problems based on the foods shown in the chart on page 232, using current prices.

6. A pound of crackers equals $1\frac{1}{2}$ lb. of bread in energy value. Why is this true? Compare their costs.

7. A pound of rice in energy value equals a pound of macaroni. Compare their costs.

8. When a certain variety of apples was retailing at 10¢ a lb., the same variety at a special sale cost only $2.85 per box of 42 lb. net. What was the % of saving when bought by the box?

9. In Oct., 1919, potatoes sold in a large city at $2.00 per bu. In March, 1920, they sold at 10¢ a lb. What % was saved on every pound, used in March, but bought in October?

10. People who have storage room for potatoes and apples usually buy their winter supply in the autumn. Do you see why?

11. Canned corn which retails at 15¢ per can is usually sold at $1.50 per dozen. If a family needs 3 dozen cans, what is the % of saving by buying at wholesale?

12. In May, 1920, the price of old potatoes was 10¢ a lb.; of new ones it was 20¢ a lb. If the larger waste in peeling old potatoes is offset by their higher food value, what is the % of saving in buying old potatoes?

Home and School Problems

1. When sweet potatoes were selling at 11¢ per lb., Irish potatoes sold at 10¢ a lb. In energy value 1 lb. of sweet potatoes equals $1\frac{1}{2}$ lb. of Irish potatoes. What % is saved for each pound of sweet potatoes bought?

2. In May, 1920, a 48-lb. sack of flour sold at $4.10, and a 12-oz. loaf of bread sold at 10¢. What was the % of saving by baking at home if it requires 9 oz. of flour, $\frac{1}{2}$¢ worth of other ingredients, and $\frac{3}{4}$¢ worth of fuel for each loaf? Carry results to tenths of a mill.

3. At the prices stated in the previous problem how much money does the housewife save by baking at home for each 48-lb. sack of flour used? Allow 1% of the flour as waste in making the dough.

4. In a large city during 4 months of 1919 the school children collected 682002 lb. of newspapers and 78345 lb. of magazines.

(1) How many tons were there in the total?

(2) If during this period the average price of old newspapers was $1.15 per 100 lb., what was the value of the average monthly collection?

(3) The average price for old magazines was $2.45 per 100 lb. Find the value of the average monthly collection.

(4) Find the total value of old paper collections for the four months.

(5) At the rate for the first four months what would be the value for the next five?

(6) At this rate what would be the value for the nine calendar school months?

A Missouri teacher bought for \$200 an acre of land containing the following apple trees: Rome Beauty 14; Arkansas Black 16; Ben Davis 20. In 1919 the total production and value were as follows: Rome Beauty 10 bbl. No. 1 @ \$3.75, 6 bbl. No. 2 @ \$3.00; Arkansas Blacks 10 bbl. No. 1 @ \$3.75, 8 bbl. No. 2 @ \$3.00; Ben Davis 12 bbl. No. 1 @ \$3.50, 6 bbl. No. 2 @ \$2.75; 8 bbl. of windfalls @ \$2.50, windfalls sold in baskets and sacks for \$11.50; 10 gallons of cider at 35¢; culls fed to 4 hogs for 2 months, estimated at \$4 per hog.

The cost of growing and marketing the crop was as follows: pruning, 3 days @ \$2; spray materials, \$7; spraying, 4 times, requiring each time 2 men working 4 hours, at 25¢ per hr.; picking, sorting, and packing, 40¢ a bbl. (omit the windfalls not in barrels); empty barrels, 49¢ each; drayage to freight station $\frac{1}{4}$ mile from the orchard, \$4.50.

Compute the interest on the cost of the land at 6%. The tax was \$1.60 per \$100 on an assessed value of \$150.

1. Find the total receipts from the orchard.

2. Find the average receipts per tree.

3. Find the total cost of the crop including interest on the land and the tax.

4. Find the average cost per tree.

5. Find the net earnings of the orchard.

6. Find the net earnings per tree.

7. What % of the entire cost is the cost of picking and marketing (3 items)?

8. What % net did the orchard earn?

9. Is it safe to expect such a crop as this each year?

Thrift in Growing Corn

I. This is the record of the cost and production of one acre of corn as kept by a Missouri corn-club boy. Find the value of each question mark.

Date		Record of Work and Cost*	Value
Mar.	3	2 hr. making seed tester @ 15¢	?
"	18	1 hr. selecting and testing seed	?
"	18	Cost of seed	$0.50
"	30	" " fertilizer	2.50
Apr.	3	4 hr. labor, boy and team, plowing @ 65¢ . .	?
"	15	1 hr. " " " " harrowing	$0.65
May	10	2 hr. " " " " planting @ 65¢ . .	?
"	25	1 hr. " " " " harrowing	?
"	28	1 hr. thinning	$0.15
"	29	1½ hr. labor, boy and team, cultivating @ 65¢	?
June	4	1½ hr. " " " " " @ 65¢	?
"	15	1½ hr. " " " " " @ 65¢	?
"	25	1½ hr. " " " " " @ 65¢	?
July	3	1½ hr. " " " " " @ 65¢	?
Oct.	30	12 hr. husking @ 15¢	?
"	31	3 hr. hauling @ 65¢	?
Nov.	15	Rent on land	$5.00
		Total cost of growing one acre . . .	?
Nov.	2	Sold 68 bushels @ $1.20	?
		Net profit on one acre	?

* NOTE.—The above record is made in full to give city children and others a reading knowledge of scientific corn growing as practiced by thousands of boys in our country.

II. This is a summary of an account kept by an Ohio farmer with a 10-acre field of corn in 1918.

March	Cost of seed corn, \$5. Testing seed, 8 hr. @ 25c. Fertilizer, \$25.
April	Plowing, 1 man and team, 66 hr. @ 75¢.
May	Harrowing, 20 hr. @ 75¢. Planting 10 hr. @ 75¢.
May, June, July	Cultivating 4 times, each cultivation requiring 15 hr. @ 75¢.
October	Gathering 610 bu. shelled corn, 75 hr. man and team @ 75¢; helper, 75 hr. @ 25¢.
December	Interest at 6% for 6 months on the land worth \$150 per acre.
	Sold the crop in the crib at \$1.40 per bu.

(1) Find the gross profit.

(2) What item not shown above must be subtracted to find the net profit?

(3) Suppose the field had yielded only 30 bushels per acre, due to an August drouth, and the market price had been \$1.00 per bushel, what would have been the gross profit in the above problem?

(4) Find the net profit at the current price of labor and of corn.

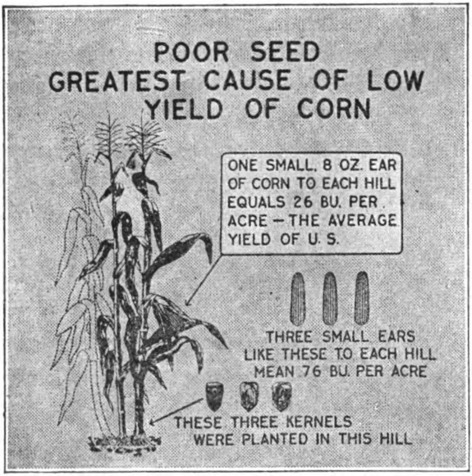
(5) Is corn a profitable crop in your community?

(6) Is there a close relation between the price of hogs and of corn? Between the price of hogs and of wheat? See the market columns of the newspaper.

III. In a certain experiment it was found that 112 grains out of 172 grains of corn six years old sprouted. The same corn when one year old made 98% in a sprouting test. What was the loss of vitality in per cent in 5 years?

Sometimes corn one year old sprouts (germinates) only $\frac{1}{3}$ of the grains planted. What lesson may a careful farmer learn from the experiment described on page 237?

IV. Study the chart, and from it solve the problems below.



(1) How many hills are planted on an acre if an 8-ounce hill yields 25 bu. to the acre? (A bushel of ear corn weighs 70 pounds.)

(2) What is the average weight per ear of the small ears in the picture which yield 76 bu. to the acre?

(3) Fred Dobbins of Cedarville, O., in a recent year averaged 104 bushels of corn to the acre. On a basis of 3 ears to the hill, what was the average weight per ear?

(4) The difference between a good yield of corn and a poor one, with the same soil and climatic conditions, is largely the difference between good seed and poor seed. When should seed corn be selected? Why should it be tested before planting?

V. If corn sold at \$1.50 per bushel on Oct. 1, 1918, and the same quality sold at \$1.80 on July 1, 1919, how much

a bushel was made by holding until July? Allow 1% a month for shrinkage and other loss in the crib, and 6% interest on the money from October to July.

I. James McMillen, an Ohio pig-club boy, purchased on May 23, 1918, a 37-pound Poland-China pig, 2 months old. Later weights were as follows: July 8, 112 lb.; Sept. 12, 229 lb.; Nov. 2, 378 lb.; Dec. 21, 515 lb.

(1) Find the average daily gain for each period.

(2) During which period was the per cent of gain greatest?

(3) Construct a graph showing the growth from May 23 to Dec. 21.

II. Another Ohio pig-club boy raised a pig whose weight record was as follows: 3 months old, 40 lb.; 6 months old, 110 lb.; 9 months, 220 lb.; 12 months old, 300 lb.

(1) During which 3 months' period did the pig make the highest % of gain?

(2) During which period the lowest % of gain?

(3) During which period did the pig make the largest average daily gain?

(4) If it required 12 bu. of corn and $2.50 worth of other feed to raise the above pig until it was 6 months old, at the current price of hogs and corn did the pig show a profit, or a loss, at 6 months of age?

(5) It required 10 bu. of corn worth \$1.50 a bu. and \$2.00 worth of other feed to feed the pig between the age of 6 months and 9 months. Did this period show a profit or a loss if hogs were worth 17¢ a lb.?

(6) Compare the rate of growth of this pig with the Poland-China in I. Both pigs received the same care and the older one consumed more feed. How do you account for the difference?

III. In dry lot feeding, 7 lb. of shelled corn are allowed daily to a 200-lb. pig. On clover pasture only $\frac{1}{2}$ this amount of corn is necessary to get the same gain.

(1) What is the daily value of the clover pasture for each 200-lb. pig?

(2) If the daily increase is $1\frac{1}{2}$ lb. in weight, how much per bushel is the owner getting for the corn fed in the dry lot, not counting his labor?

IV. A balanced ration for growing pigs is 6 lb. of shelled corn, 3 lb. of shorts, and 1 lb. of oilmeal. Skimmed milk, or buttermilk, may replace partly or wholly the shorts and oilmeal on the basis of 3 lb. of milk to 1 lb. of corn.

(1) If a boy can procure daily 24 lb. of skimmed milk, how much corn will balance this amount?

(2) How much shorts and oilmeal must the boy add to the milk to balance a daily ration of 12 lb. of corn to get the best results?

V. A pig with ordinary care and proper feed (12 bu. of corn and \$2.50 of other feed), weighing 115 lb. at 6 months of age, is a "scrub hog." A thoroughbred at the same age with the same care and feed weighs on an average 200 lb.

(1) At current prices of hogs and corn, what is the difference in profit between the two types?

(2) What does the farmer mean when he says, "My pigs are eating their heads off"? How may he remedy this condition?

VI. It is estimated that 100 lb. of shelled corn fed to a hog will increase its weight 20 lb.

(1) If hogs are worth $16 a hundred-weight and corn $1.30 per bu., would a farmer gain, or lose, by feeding his crop of corn to his hogs? 56 lb. of shelled corn = 1 bu.

(2) If his crop is 800 bushels, find the gain or loss.

(3) The above estimate is based on dry lot feeding. If the corn is fed in clover pasture, only half the amount of corn named above is needed to make 20 lb. of increase. Use the information in this section to help you in the next one.

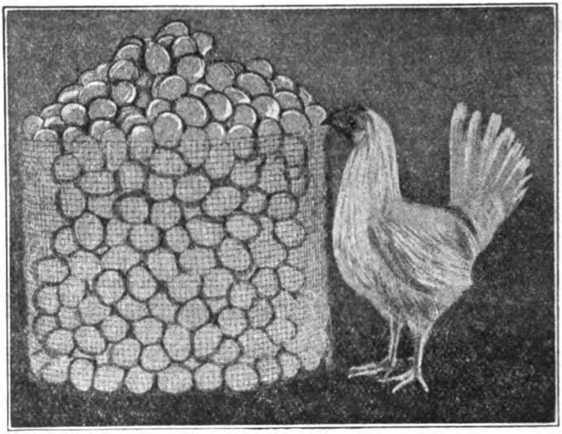
VII. In July, 1919, good hogs sold at $22 per hundred-weight and corn was worth $1.80 per bushel.

(1) What profit on his corn did the farmer make each day, who fed 100 bushels of shelled corn in 20 days to July hogs in a dry lot?

(2) How many hogs was he feeding if he allowed each hog 7 lb. of shelled corn daily?

(3) How many might he have fed in clover pasture with this amount of corn? Would his profit have been greater by feeding in clover? Why?

VIII. A hog weighing 650 lb. on foot was sold in 1919 at 22¢ a lb. What do you think about the size of the hog and the price per lb.?



Keeping Poultry for Profit

I. Missouri Queen was a Single-Comb White Leghorn hen at the Missouri Poultry Experiment Station. This remarkable hen completed her 1000-egg record April 10, 1919. This is her record: 1914, 222 eggs; 1915, 187 eggs; 1916, 217 eggs; 1917, 149 eggs; 1918, 177 eggs. She weighed $4\frac{1}{2}$ lb., and it cost on an average the value of 110 eggs to feed her each year. The weight of the eggs was 121.8 lb.

(1) Find the number of eggs laid in 1919 to complete the 1000-egg record.

(2) If the record up to April 10 was continued through the year, find the 1919 egg production.

(3) Construct a graph showing the egg record for 6 years.

(4) Compute the % of profit earned for her owner each year.

II. This table shows a one-year egg record kept by Miss Bertha Stanford, age 15, an Atchison Co. (Mo.) poultry-club girl.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1.	0	6	1	17	14	13	13	19	16	16	3	0	?
2.	0	3	3	16	15	13	13	18	15	16	2	0	?
3.	0	2	5	15	14	14	14	18	15	16	2	0	?
4.	0	1	6	15	14	14	14	18	14	15	2	0	?
5.	0	0	8	15	14	15	13	17	14	15	1	0	?
6.	0	0	9	18	13	15	14	17	14	15	1	0	?
7.	0	0	10	18	14	15	14	17	14	15	1	0	?
8.	0	0	12	18	13	16	15	17	14	14	0	0	?
9.	0	0	13	13	14	16	16	18	16	13	0	0	?
10.	0	0	15	13	13	16	18	17	15	11	0	0	?
11.	0	0	15	13	13	16	20	17	15	11	0	0	?
12.	0	0	15	13	13	15	18	18	15	11	0	0	?
13.	0	0	17	12	14	15	18	18	16	11	0	0	?
14.	0	0	17	15	15	14	18	18	16	11	0	0	?
15.	0	0	17	15	16	15	18	18	16	10	0	0	?
16.	0	0	19	16	16	14	19	17	16	9	0	0	?
17.	0	0	20	16	16	13	19	17	16	9	0	0	?
18.	0	0	20	15	16	13	19	18	16	9	0	0	?
19.	1	0	20	14	15	13	18	17	16	7	0	0	?
20.	2	0	19	15	15	14	18	16	17	7	0	0	?
21.	2	0	19	14	16	14	18	16	18	7	0	0	?
22.	3	0	20	14	15	14	19	15	18	6	0	0	?
23.	4	0	17	14	14	15	19	15	18	6	0	0	?
24.	3	0	16	13	14	15	20	14	19	6	0	1	?
25.	4	0	17	13	14	15	20	15	18	5	0	2	?
26.	5	0	16	14	14	16	19	15	19	4	0	2	?
27.	5	0	18	15	13	16	20	16	18	5	0	2	?
28.	5	0	17	15	13	15	19	16	17	4	0	3	?
29.	5		18	15	13	14	18	16	17	4	0	3	?
30.	6		18	14	14	14	19	16	17	3	0	4	?
31.	6		18		0		19	16		3		5	?
Total	?	?	?	?	?	?	?	?	?	?	?	?	??

(1) What was the monthly production? The total daily production?

(2) Find in two ways the total number of eggs laid during the year.

(3) Construct a graph showing the relative monthly yield.

(4) In 1918 the average price of eggs per dozen for each month beginning with Jan. was as follows: 60¢, 55¢, 40¢, 34¢, 30¢, 29¢, 27¢, 29¢, 31¢, 35¢, 50¢, 62¢. At these prices find the value of each month's egg production.

(5) Construct a graph, showing the relative monthly value of eggs laid. Construct a graph, showing the monthly fluctuation in the price per dozen.

(6) Miss Stanford reported the cost of the feed for the year to have been $20. What was the excess of egg value over feed cost?

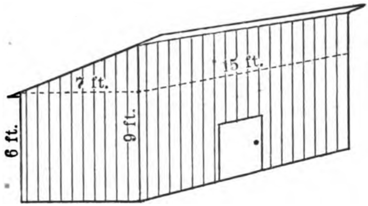
(7) Study the egg record once more, take into consideration the feed cost, then suggest a possible method of increasing the egg production during the winter months. Why is such an increase desirable?

III. In March, 1918, James Vaughn, age 12, a Monroe Co. (Mo.) poultry-club boy, went into the poultry business. He built two houses, costing $25, and one coop, costing $5.00. He paid $1.50 for 5 doz. hatching eggs, $5.00 for 8 laying hens, and $10.00 for feed. He sold 8 head of market poultry @ 80¢, 10 fowls for breeding purposes @ $1.00, and 30 doz. market eggs at an average of 45¢ per doz. On Nov. 1, he had on hand his poultry houses, 10 young roosters, 8 hens, and 17 pullets. He valued the roosters at 85¢ each, the hens at $1.00, the pullets at $1.25. He allowed 20% for depreciation on his poultry houses.

(1) Make an account showing this boy's financial condition on Nov. 1 with regard to his poultry project.

(2) What in your judgment should the boy have done with the young roosters before Dec. 1?

IV. This is a cut of Harry's poultry house. The roof projects 6 inches over each side.



(1) How long must Harry cut the boards for the roof?

(2) How much lumber one inch thick will be needed for the roof and sides?

(3) What other lumber did he need?

(4) How much will it cost to paint the entire outside surface at 15¢ a square yard?

Mixed Problems

1. How many thrift stamps can Henry buy with one year's interest from his $100 Victory Bond if it earns $4\frac{3}{4}\%$?

2. A family spends $600 for rent, $2400 on other expenses, and saves $600. If they increase their total expenses to $3500 and their savings in the same ratio, how much will they save?

3. Three girls start a lemonade stand. The first invests 50¢, the second 75¢, and the third $1.25. At the end of the day they have a profit of $3. What is each girl's share?

4. A certain brand of soup sells at 13¢ for 11 oz. net. Another brand equally good sells at 15¢ for 17 oz. net. What is the rate of saving by buying the latter?

5. After cutting from a $12\frac{1}{2}$ lb. cheese three pieces which were said to weigh $2\frac{3}{4}$ lb., $1\frac{1}{2}$ lb., and $\frac{3}{4}$ lb. respectively, it was found that exactly $7\frac{1}{4}$ lb. remained. On the average how nearly accurate was the clerk who weighed the pieces?

6. Some bolts of cloth contain exactly 50 yards. After cutting pieces which were said to measure as follows: 3 yd., $2\frac{1}{2}$ yd., $6\frac{3}{4}$ yd., $\frac{1}{2}$ yd., 10 yd., and $4\frac{1}{4}$ yd., exactly $22\frac{3}{4}$ yd. were left. If the cloth was worth $2.40 a yard, how much, due to careless measuring, on the average did it cost the store each time a piece was sold? Do you see why some clerks in a large store are promoted more rapidly than others?

7. A young working man earning 50 cents an hour took a 6-months' business course at night school. The tuition was $60, including all the necessary books and stationery. Car fare cost him 10¢ a day. In order to do this, he lost one hour daily from his work. How much did the course cost him?

8. On Feb. 7 the reading on my gas meter was 378300 cu. ft.; on Jan. 8 it was 376100 cu. ft. The bill was computed at 95¢ per 1000 cu. ft., with 10% off for prompt payment. What was the saving if the bill was paid promptly?

9. When the gross electric light bill was $3.18, by prompt payment, $3.02 settled the bill. What was the % of saving?

10. Those who have studied the problem carefully have estimated that $\frac{1}{2}$ gallon of gasoline is wasted daily by the owner of each of 6,000,000 passenger cars in the United States through useless mileage, overuse of cars, and carelessness. One gallon of gasoline provides the energy to move 15 tons of freight one mile. The wasted gasoline is equal to the freight haul of how many tons for one mile?

CHAPTER IX

HOW MONEY EARNS MONEY

1. Mr. John Fry needed $200 to finance his cotton crop. Mr. Adam Smith, a neighbor, had $200 lying idle in his bank. Fry offered Smith $8, to be paid at the end of 6 months, for the use of his $200 for 6 months. How might Smith put this idle money to work?

2. This is the note which Fry signed.

> *$200⁰⁰/100* Edna, Texas, *June 14, 1920*
>
> *Six months* after date *I* promise to pay
>
> *Adam Smith* or order,
>
> *Two Hundred* Dollars
>
> with interest at 8% per annum. For value received.
>
> *John Fry*

(1) Who will keep this note?

(2) What name is given the $200?

(3) On what day will the note be due?

(4) How much interest will be due on this day?

Interest is money paid for the use of money.

The principal is the money which is used.

The rate of interest is the per cent of the principal paid for the use of the principal for one year.

The amount is the principal plus the interest due at settlement.

From the definitions on the previous page a general rule for finding interest may be written as a formula, thus:

$$\mathbf{I = P \times R \times T}$$

in which I = interest, P = principal, R = rate of interest, and T = time in years or part of a year.

Explain and then solve by cancellation.

(1) $\text{Interest} = \$200 \times \frac{6}{100} \times \frac{11}{12}.$

(2) $\text{Interest} = \$200 \times \frac{8}{100} \times \frac{152}{360}.$

(3) $\text{Interest} = \$250 \times \frac{4}{100} \times \frac{410}{360}.$

Find the interest and the amount due on each of these notes.

	Principal	Rate	Time to Run	Interest	Amount
1.	$ 600	5%	2 yr.	?	?
2.	$ 450	6%	3 yr.	?	?
3.	$ 50	4%	6 mo.	?	?
4.	$1000	3%	3 mo.	?	?
5.	$ 250	8%	1 yr. 6 mo.	?	?
6.	$ 300	7%	1 yr. 4 mo.	?	?
7.	$ 300	8%	1 yr. 5 mo.	?	?
8.	$ 400	6%	1 mo.	?	?
9.	$ 600	6%	15 da.	?	?
10.	$ 800	5%	20 da.	?	?

Problems

1. A man bought a house and lot for $4800. He paid $1000 cash and gave his note for the balance at 6% interest, payable annually, for three years. How much interest was paid?

2. Harry owned a $100 Liberty Loan 4% bond on which the interest was paid every 6 months. How much did he get at each interest period? How much interest did he get in 2 years? How much in $3\frac{1}{2}$ years?

3. A girl said, "The interest on $150 at 6% for 1 yr. is $9.00, for 1 month it is $.75, and for 1 day it is $.025." Was she right? There are 30 days in an interest month and 360 days in an interest year.

4. Find the interest on $300 at 5% for 1 yr. For 1 mo. For 1 da.

5. How would you find the interest on $160 at 6% for 1 yr. 1 mo. 1 da.?

6. Banks prefer to loan money for a short time, such as 30 days, 60 days, or 90 days.

7. Find the interest and amount due on each of these notes.

	Principal	Rate	Time to Run	Int.	Amt.
1.	$350	4%	60 days	?	?
2.	$400	$3\frac{1}{2}$%	90 days	?	?
3.	$240	7%	30 days	?	?
4.	$100	8%	45 days	?	?
5.	$280	6%	120 days	?	?

Exact or Accurate Interest

Exact interest is the interest found when you consider 365 days, or in leap year 366 days, as an interest year. This method of computing interest is employed by the United States Government and occasionally by banks and individuals. In all cases where the time is less than one year, the exact number of days must be found.

1. Find the exact interest from Mar. 5, 1921, to May 7, 1921, on \$320 at 6%.

The time = 26 days (left in Mar.) + 30 days (April) + 7 days (May) = 63 days.

The exact interest $= \$320 \times \frac{6}{100} \times \frac{63}{365}$.

Complete the computation.

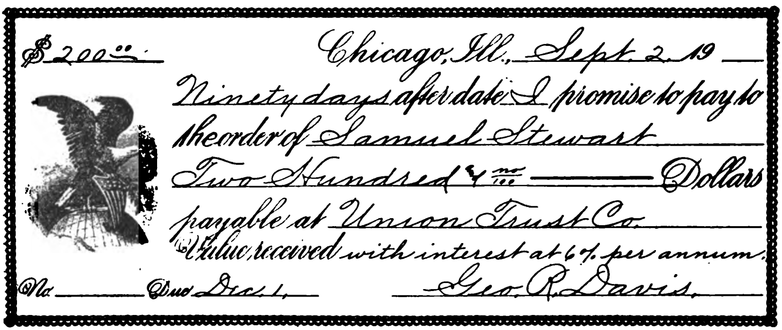
2. A man gave his note on June 6, 1921, for \$120 at 5% interest, due Sept. 20, 1921. Find the exact interest and the common interest.

3. Find the difference between exact and common interest on a note of \$1000 at 7% interest, running for 73 days in 1920.

HINT.—1920 is a leap year.

4. Charles said the exact interest on \$400 at 6% for 55 days in 1920 was 36¢. How great an error did he make?

Promissory Notes



\$200.00/100 Chicago, Ill., Sept. 2, 19__

Ninety days after date I promise to pay to the order of Samuel Stewart

Two Hundred & 00/100 ——— Dollars

payable at Union Trust Co.

Value received with interest at 6% per annum.

No. ______ Due Dec. 1, ______ Geo. R. Davis.

A TIME PROMISSORY NOTE

1. A promissory note is a written promise to pay to someone, or his order, a certain sum of money on demand, or on a specified day.

2. Important elements of a promissory note.

(1) A promise to pay money to someone by someone.
(2) The amount promised usually stated in figures and words.
(3) Date of note and place given.
(4) Time to run.
(5) If interest bearing, the phrase *with interest* and the rate % per annum.
(6) Value received.
(7) The place at which payment is to be made.

3. The signer of the note is the **maker.**

4. The person to whom the promise is made is the **payee.**

5. The sum named in the note is the **face.**

NOTE.—You should be careful not to confuse **principal** with **face.** The former belongs to interest, the latter to promissory notes, checks, drafts, bonds, stocks, etc.

6. A note payable to bearer can be collected by anyone who holds it when due.

7. A note payable to a certain person or order can be sold by the payee's indorsing it (writing his name on the back).

8. "Bearer" and "or order" promissory notes are said to be negotiable because they can be bought and sold.

9. Notes without the words "bearer," or "or order," are non-negotiable. Such notes cannot be bought and sold. They are payable to the payee or his legal representative.

10. Write a non-negotiable, non-interest bearing note.

Buying and Selling Promissory Notes

1. Negotiable promissory notes are property and consequently may be bought and sold.

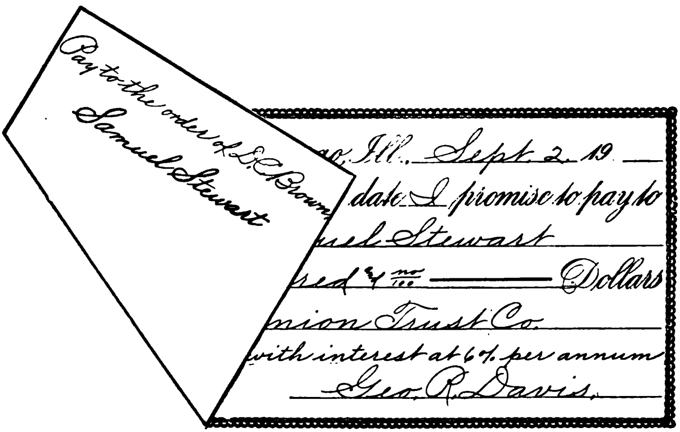
2. If the note contains the phrase "or order," then the seller must write his name across the back of it. This is called indorsing the note.

3. "Bearer" notes can be sold without indorsement.

4. Write a ninety day, 6%, promissory note, in which one of your classmates is the payee and you are the maker. Have the payee sell the note to another of your classmates.

Indorsements—Kinds and Meaning

1. An indorsement, as applied to promissory notes, is evidence on the back of a note showing transfer. See indorsement on note below.



2. This indorsement shows that D. C. Brown bought from Samuel Stewart the note signed by Geo. R. Davis in favor of Samuel Stewart.

3. The form of the indorsement, "to the order of," shows that D. C. Brown may in turn sell this note. In such event he becomes an indorser.

4. Indorsement in blank.

Samuel Stewart.

This consists of the signature of the seller (payee) and nothing more. Samuel Stewart becomes liable for the note if the maker fails to pay it when due, and blank indorsement makes the note payable to bearer.

5. Indorsement in full.

Pay to D. C. Brown, or order,
Samuel Stewart.

This is a statement showing to whom the note is sold, followed by the signature of the seller (payee). Samuel Stewart becomes responsible to D. C. Brown or any subsequent owner of the note if the maker fails to pay it at maturity.

6. Indorsement without recourse.

Pay to D. C. Brown, or order,
without recourse on me,
Samuel Stewart.

Samuel Stewart does not assume any responsibility for the payment of the note. Who may object to this form of indorsement? What effect may it have on the selling price of the note?

Valuable Information about Promissory Notes

1. Notes bear interest only if so stated. If no rate is mentioned, then the legal rate of the state in which the note is made is used. This rate is commonly 6%.

2. A note made on a Sunday or a legal holiday is good.

3. Signatures made with a lead pencil are legal.

4. "Value received" is usually written in the note. If not written, it is presumed by the law or may be supplied by proof.

5. An indorsee has a right to sue all whose names were on the note when he received it, except those who signed without recourse. He may sue any one or all in any order.

6. If a note is lost or stolen, it does not release the maker. He must pay if the amount and the consideration for which it was given can be proven.

7. A note obtained by fraud, but owned by an innocent purchaser, must be paid.

8. Notes falling due on a Sunday or a legal holiday are usually collected on the last preceding or next succeeding business day.

9. Days of grace are abolished in most states.

10. A note antedated or post dated is good.

11. All notes, whether interest bearing or non-interest bearing, bear interest after maturity if not paid when due.

Finding the Maturity Date of Notes

1. If the time to run is stated in years or months, count by years or months from date of issue.

EXAMPLE.—A note dated Aug. 10, 1920, due in three months matures Nov. 10, 1920.

2. If the time to run is stated in days, count by days from date of issue.

EXAMPLE.—A note dated Aug. 10, 1920, due in 90 days matures in 90 days from Aug. 10, which is Nov. 8.

Finding the Time between Date of Issue and Settlement

1. When the time is part of a month, count the actual number of days.

2. When the time is longer than a month and shorter than a year, two methods are used.

I. Count whole months and the actual days for the part less than a month.

EXAMPLE.—Find the time between Aug. 10 and Nov. 3.

From Aug. 10 to Oct. 10 is 2 months. From Oct. 10 to Nov. 3 is 24 days. The time is 2 mo. 24 da.

II. Count actual days elapsed between the two dates.

By this method the time from Aug. 10 to Nov. 3 is 85 days. Prove this result by counting.

This is the method more commonly employed by bankers.

For determining quickly the number of days between two dates bankers use a Day Table. Such a table is found on page 256.

3. When the time is longer than one year, two methods may be used.

I. Count full years, then full months, then actual days for part less than one month.

EXAMPLE.—Find the time between Sept. 29, 1919, and June 23, 1922.

From Sept. 29, 1919, to Sept. 29, 1921, is 2 yr. From Sept. 29, 1921, to May 29, 1922, is 8 mo. From May 29, 1922, to June 23, 1922, is 25 da.

This is expressed more briefly thus: From 8/29/1919 to 6/23/1922 is 2 yr., 8 mo., 25 da.

II. Count full years only and the actual days for the time less than a year.

Thus in the problem above, there are 2 full years, and the time from Sept. 29, 1921, to June 23, 1922, is 267 days, found by actual count or by the table on page 256. Bankers usually use method II.

From / To	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.	365	31	59	90	120	151	181	212	243	273	304	334
Feb.	334	365	28	59	89	120	150	181	212	242	273	303
Mar.	306	337	365	31	61	92	122	153	184	214	245	275
Apr.	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	30	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
Aug.	153	184	212	243	273	304	334	365	31	61	92	122
Sept.	122	153	181	212	242	273	303	334	365	30	61	91
Oct.	92	123	151	182	212	243	273	304	335	365	31	61
Nov.	61	92	120	151	181	212	242	273	304	334	365	30
Dec.	31	62	90	121	151	182	212	243	274	304	335	365

A Table for finding the number of days between two dates.

How to Make a Day Table

1. The above table enables one to see at a glance how many days there are from **a certain** day of a **given** month to the **corresponding day** of **any** month. This table is frequently used by bankers. Why?

2. Study the table to find out how it is constructed.

HINTS. (1) How is the top line obtained?
(2) How is the first column obtained?

3. Study it to discover if there are errors in it.

4. Would a single error in such a table do much harm? Why?

How to Use the Day Table

1. How many days from Feb. 10 to Aug. 10, 1919?

Look for Feb. on left side and August at the top. In the angle is 181. There are 181 days from Feb. 10 to Aug. 10, 1919.

2. How many days from Oct. 5, 1919, to May 5, 1920?

In leap year add one day when February is included. Why?

ing the table as before, we find 212 in the angle.

1920 is a leap year and February is included between Oct. 5 and May 5. Therefore there are 213 days between Oct. 5, 1919, and May 5, 1920.

3. How many days from July 8 to Dec. 8, 1920?

153 is in the angle July to December. 1920 is a leap year, but February is not included in our problem. There are consequently 153 days from July 8 to Dec. 8, 1920.

The table shows the number of days from a **certain** day of a **given** month to the **same day** of **any** month, as Jan. 5 to Nov. 5. You can also use the table for **any** two dates whose difference is 365 days or less. See the next problem.

4. How many days from Jan. 5 to Sept. 18, 1921?

By the table there are 243 days from Jan. 5 to Sept. 5. From Sept. 5 to Sept. 18 there are 13 days. Therefore from Jan. 5 to Sept. 18, 1921, there are 256 days.

5. How many days from Aug. 29, 1920, to Apr. 2, 1921?

Aug. 29 to Mar. 29 = 212 days. See table.
Mar. 29 to Apr. 2 = 4 days. Actual count.
Therefore Aug. 29, 1920, to Apr. 2, 1921 = 216 days.

Practice in Using the Day Table

Find how many days from

1. Jan. 5 to Nov. 5.
2. Feb. 2 to Sept. 22.
3. Mar. 15 to Dec. 15.
4. Apr. 15 to Dec. 3.
5. Oct. 9 to Dec. 2.
6. From Feb. 29 to July 31.
7. 7/4, 1923, to 3/4, 1924.
8. 3/4, 1924, to 10/12, 1924.
9. Christmas, 1920, to Washington's birthday, 1921.

10. Washington's birthday, 1924, to Independence day, 1924.

11. The opening of your school to the close of it.

12. Labor Day of the current year to Christmas Day of the same year.

13. Christmas Day of the current year to Washington's birthday of the next year.

14. Your birthday to the next July 4.

Settling Promissory Notes

$\$200^{00}/_{100}$ Chicago, Ill., *Sept. 10, 1919.*

Two years ~~~~~~~~~~ after date *I* promise to pay

~~~~~~~~~~ *John Jones* ~~~~~~~~~~ or order at the

Continental and Commercial National Bank

Two Hundred ~~~~~~~~~~~~~~~~~~~~ Dollars

with interest at 6% per annum. For value received.

John Doe.

The above note was not paid until June 2, 1923. How much money was required to settle it?

1. The time between 9/10, 1919, and 6/2, 1923, is 3 yr. 265 da. Prove this result.

NOTE.—When the time interval in interest and discount problems in this text is less than one year, count the actual number of days. To shorten your work use the Day Table on page 256. This is the usual custom of banks.
~~~~~~~~~~

2. The interest on \$200 at 6% for 3 yr. 265 da. is \$44.83. Prove this result.

3. What is the amount due?

4. Find the amount due at date of settlement on each of the following notes.

	Date of Note	Face	Rate of Interest	Date of Settlement	Maker	Payee
(1)	2-8-18	\$200	6%	3-9-21	Jas. Jay	Yourself
(2)	5-20-19	800	4%	7-24-21	John Fox	R. Stone
(3)	6-3-20	500	7%	1-15-22	Yourself	J. Q. Adams
(4)	2-5-19	250	6%	2-17-24	Lucy Smith	May Jones
(5)	1-18-18	300	5%	3-12-20	Jane Mills	May Wade

5. Using the name of a bank in your vicinity, write the proper check for each of the above settlements.

NOTE.—In leap years February has 29 days.

A Short Test on Promissory Notes

1. Name the date, the maturity, the face, the maturity value, the place of payment, the payee, and the maker in the note on page 250.

2. Write a time, interest bearing, negotiable, promissory note.

3. A demand note becomes due at the option of the payee. Write a demand negotiable note.

4. What is the difference between principal and face?

5. What is the effect on a promissory note if it be indorsed in blank? What if indorsed without recourse?

6. Why do money lenders prefer to write 90-day notes rather than 3-month notes.

This is an interest table such as bankers use when they wish to find interest quickly. Study it to see if you can discover how it is made.

Simple Interest Table—Rate 6%

Days	$900	$800	$700	$600	$500	$400	$300	$200	$100
90	$13.50	$12.000	$10.500	$9.00	$7.500	$6.000	$4.50	$3.000	$1.500
60	9.00	8.000	7.000	6.00	5.000	4.000	3.00	2.000	1.000
50	7.50	6.666	5.833	5.00	4.166	3.333	2.50	1.666	.833
40	6.00	5.333	4.666	4.00	3.333	2.666	2.00	1.333	.666
30	4.50	4.000	3.500	3.00	2.500	2.000	1.50	1.000	.500
20	3.00	2.666	2.333	2.00	1.666	1.333	1.00	.666	.333
10	1.50	1.333	1.666	1.00	.833	.666	.50	.333	.166
9	1.35	1.200	1.050	.90	.750	.600	.45	.300	.150
8	1.20	1.066	.932	.80	.666	.532	.40	.266	.132
7	1.05	.933	.816	.70	.583	.466	.35	.233	.116
6	.90	.800	.700	.60	.500	.400	.30	.200	.100
5	.75	.666	.583	.50	.416	.333	.25	.166	.083
4	.60	.533	.466	.40	.333	.266	.20	.133	.066
3	.45	.400	.350	.30	.250	.200	.15	.100	.050
2	.30	.266	.233	.20	.166	.133	.10	.066	.033
1	.15	.133	.116	.10	.083	.066	.05	.033	.016

Computing Interest by Means of an Interest Table

1. Find the interest on $200 for 45 days.

HINT.—In the $200 column find the interest for 40 days ($1.333), and add to it the interest for 5 days ($.166).

2. Find the interest on $980 for 90 days.

HINT.—The interest on $900 for 90 da. ($13.50) + the int. on $80 for 90 da. ($1.20) = $14.70.

3. Find the interest on $120 for 63 days.

HINT.—The int. on $120 for 60 da. ($1.00+$.20) +the int. on $120 for 3 da. ($.05+$.01) = $1.26.

The preceding explanation is given as a help in understanding the table. In actual practice the interest addends are written at once from the table; thus, in problem three $1.20 + $.06 = $1.26.

4. Write from the table the interest for each of these examples.

	Principal	Time		Principal	Time
(1)	$ 140	63 days	(11)	$225	60 days
(2)	$ 120	60 days	(12)	$335	90 days
(3)	$ 200	95 days	(13)	$468	50 days
(4)	$ 130	120 days	(14)	$985	45 days
(5)	$ 840	42 days	(15)	$114	22 days
(6)	$ 950	33 days	(16)	$ 75	65 days
(7)	$1000	28 days	(17)	$ 84	93 days
(8)	$ 560	21 days	(18)	$105	100 days
(9)	$ 420	18 days	(19)	$209	180 days
(10)	$ 550	31 days	(20)	$345	19 days

5. Some pupils have used the 6% table to solve this problem: "Find the interest on $90 for 60 days at 7%." Do you see how they did it?

6. If you understand problem 5 solve this one, using the interest table: "Find the interest on $240 for 40 days at 8%."

7. On heavy paper construct an 8% interest table.

Paying Interest on What You Owe

When a note is given, it is often agreed by both parties that payments may be made at any time before maturity of the note. The amount of each payment and the date on which it is made are entered on the back of the note. Such an entry is called an indorsement. See form below.

Received on this note
June 5, 1920, $20.00
Jan. 20, 1921, $35.00

\$300⁰⁰/100	Columbus, O., *Jan. 15, 1917.*

Three years after date *I* promise to pay
L. J. Chapin or order,
Three Hundred Dollars
with interest at 6% per annum, payable annually. For value received.

James Sands

How often and when is the interest due in the above note? Mr. Chapin agreed to accept at the interest period any portion of the principal, which Mr. Sands might wish to pay.

On Jan. 15, 1918, the interest due and \$50 of the principal were paid. On Jan. 15, 1919, the interest due (how much?) and \$100 of the principal were paid.

On Jan. 15, 1920, Mr. Sands found that he owed \$150 of the principal and \$9 interest. Was his computation correct?

\$400⁰⁰/100	Blessing, Tex., *Nov. 18, 1917.*

Three Years after date *I* promise to pay
J. A. Dunn or order,
Four Hundred Dollars
with interest at 8% per annum, payable annually.

Any unpaid principal at maturity of this note and all past due interest shall bear interest at the rate of 10% per annum until paid.

John Roye

Mr. Roye made these payments:

Nov. 18, 1918, all interest due;
Nov. 18, 1919, all interest due and $100;
Nov. 18, 1920, $200.

How much was due when settlement was made on Jan. 18, 1921?

John Barr bought a home for $6000, agreeing to pay $2000 cash and $200 every 3 months plus all interest at 6% on the unpaid balance. How long did it take him to pay for the home? What was the total paid for it?

Some pupils put their work in this form. Use it unless you know a better way.

Cash	$2000
In 3 mo.	200 + int. on $4000, which is $60.
In 6 mo.	200 + int. on 3800, which is ..
In 9 mo.	200 + int. on ...., which is ..
etc.	

NOTE.—A common practice in finding the time between two dates when indorsements are made is to count full years, full months, and the actual days for any part less than a full month.

Problems

1. The date of a certain $3750 note, due in 2 years, was June 1, 1919. The interest was 6% per annum, payable semi-annually. A payment of $112.50 was made on each of the following dates: Dec. 1, 1919; June 1, 1920; Dec. 1, 1920. What was due June 1, 1921?

2. A Pittsburg merchant held a note for $600, dated Nov. 1, 1919, bearing interest at 5%. Indorsements were made as follows: Feb. 1, 1920, $250; June 1, 1920, $180. Find the balance due on Sept. 3, 1920.

Discounting Notes

A good business man sometimes can borrow money at the bank on his own note, and pay the interest when the note is due. Banks call this transaction **lending money.** When they collect the interest in advance (that is, at the time the note is made), they call such a transaction **discounting notes.**

1. Does note number 1 below represent a **loan** or a **discount?** Why? Answer the same question for note No. 2.

\$600⁰⁰/100	Danville, Ky., *Jan. 24, 192—*
Sixty Days ~~~~~~~~ after date *I* promise to pay	
~~ *The First National Bank of Danville* ~~~~ or order,	
Six Hundred ~~~~~~~~~~~~~~~~ Dollars	
with interest at 6% per annum. For value received.	
Interest \$6.00	*X. Y. Smith*

NOTE NO. 1

\$600⁰⁰/100	Danville, Ky., *Jan. 24, 192—*
Sixty Days ~~~~~~~~ after date *I* promise to pay	
~~ *The First National Bank of Danville,* ~~~~ or order,	
Six Hundred ~~~~~~~~~~~~~~~~ Dollars	
For value received.	
Discount, \$6.00	*X. Y. Smith*

NOTE NO. 2

(1) When is the interest paid in note No. 1?

(2) How much must Mr. Smith pay to settle his note?

(3) When is the discount (interest paid in advance) paid in note No. 2?

(4) How much will settle this note at maturity?

(5) How much money does Mr. Smith actually get from the bank in No. 1? How much in No. 2? The sum Mr. Smith receives in note No. 2 is called *proceeds.*

(6) Do you see why banks would rather discount notes than lend money?

2. Interest is paid when the note is due or in case of a long time note at the end of each year or each half year.

3. Discount is collected **in advance.** The rate of discount varies from time to time. It is always computed on the **maturity value** of the note.

4. If the note bears interest, the maturity value is the **amount** of the note when due. If the note does not bear interest, its maturity value is the **face.**

5. If Mr. Smith owns a good note, he may sell it to the bank instead of giving his own note. This is the note which he sold on Jan. 24 to the First National Bank. On that day the bank's rate of discount was 8%.

$\$600^{00}/_{100}$ Danville, Ky., *Jan. 2, 192—*

Ninety Days after date *I* promise to pay

X. Y. Smith or order,

Six Hundred Dollars

with interest at 6% per annum. For value received.

John Doe

(1) On what day was the note on the previous page due?

(2) What was its maturity value?

(3) How many days did the bank own the note before it was due? This period is called the **term of discount** and is used in computing the discount.

(4) How much was the discount?

$$\text{Discount} = \text{Maturity value} \times 8\% \times \frac{68}{360}$$

(5) Mr. Smith received from the bank on Jan. 24 the maturity value less the discount. How much was that? This sum is called the **proceeds**.

(6) How much did the bank receive for the note at maturity? From whom?

(7) Who must pay the note in case the maker refuses to do so? To whom? Why?

6. Read the previous discussion once more, then do the following work.

(1) Write an interest bearing note which you might own.

(2) Sell it to a bank in your community.

(3) Compute the discount at 7% and find the proceeds.

(4) Write the check which should be given when the note is settled.

7. John Adams owned the following non-interest bearing notes which he sold to his bank at 7% discount:

$500 due in 6 months	$400 due in 8 months
$150 due in 2 months	$300 due in 1 month

Find the sum of money he received from the bank.

8. A 30-day note for $300 was discounted 12 days after date at 6%. Find the proceeds.

9. A 60-day note for $400, bearing 6% interest, was discounted 42 days before due at 5%. Find the proceeds.

HINT.—What is the maturity value of this note?

10. A 90-day note for $2500, dated Sept. 15, bearing 6% interest, was discounted Oct. 12 at 7%. Find the proceeds.

HINT.—Proceeds = Maturity value − Discount.

11. A certain Ohio bank in a recent month bought (discounted) the following 6% interest bearing notes. Find the date of maturity, the proceeds, the discount of each, and the sum of the discounts of all of them.

HINT.—Use the interest table on page 260 to help you in your computations.

Date of Note	Face	Time to Run	Rate of Discount	Day of Discount
(1) Mar. 18	$ 300	60 da.	8%	Apr. 15
(2) Mar. 24	1200	90 da.	6%	Apr. 17
(3) Mar. 25	2000	60 da.	7%	Apr. 17
(4) Mar. 27	100	120 da.	9%	Apr. 20
(5) Mar. 31	4000	90 da.	8%	Apr. 24

12. On Nov. 15, 1919, Adam Crane sold his house and lot to John Snyder for $8000. He received $2000 cash and took Snyder's notes, each for $2000, at 6% interest, due in one year, two years, and three years from the date of sale. Write the check and the three notes.

13. Mr. Crane held the notes exactly two years and then sold the last one to the bank at 7% discount. How much did he get for the note sold if all interest due was paid?

CHAPTER X

SAVINGS ACCOUNTS

Many banks have a savings department in which a low rate of interest (3% or 4%) is paid on savings deposits. Such an account may be opened with one dollar. Interest is generally computed and added to the account on Jan. 1 and July 1 of each year. The rules governing interest on savings deposits, followed by many banks, are these:

1. On deposits made during the first ten days of January and July, and during the first five days of any other month, interest will be allowed from the first day of the month in which such deposit is made. On deposits made after the above named days of each month, interest will be allowed from the first day of the month following the deposit.

2. Interest will not be allowed on the average balances, nor for parts of months, nor for parts of dollars, nor on sums withdrawn between January 1 and June 30, or between July 1 and December 31. In computing interest, withdrawals between these periods will be deducted from the first deposits.

EXAMPLE.—A man deposits $100 January 2, also $100 on June 1. On June 15 he withdraws $100. Under the rule stated above this man receives interest on July 1 on $100 for one month.

Problems

1. This problem shows how the above rules are used.

On Jan. 6, 1920, James Baker deposited $100 in a savings bank which paid 4% per annum, interest payable semi-annually. On Mar. 6 he deposited $50. On Aug. 9 he deposited $25. On Nov. 24 he withdrew $35. What balance was due Jan. 1, 1921?

James Baker

Date	Deposits	Interest	Withdrawals	Balance
1920				
Jan. 6	100			100
Mar. 6	50			50
July 1		2.50		152.50
Aug. 9	25			177.50
Nov. 24			35	142.50
1921				
Jan. 1		2.67		145.17

Explanation.—The interest is computed and entered on July 1 and January 1, and then it becomes a part of the balance. On July 1, 1920, Baker was entitled to interest on $100 for 6 mo. ($2.00) and on $50 for 3 mo. (50¢). See Rule 1. This interest was added to the balance on July 1.

On January 1, 1921, he was entitled to interest on $117 ($152.50—$35 Rule 2) for 6 mo. and on $25 for 4 mo. The interest due on Jan. 1, 1921, was $2.67, which made the balance on this date $145.17.

2. Find Baker's balance on July 1, 1921, if he deposited $40.75 on Mar. 2, 1921, and withdrew* $50 on June 10.

3. Was it good business for Baker to draw on his savings account on June 10 if he could have borrowed the money for a month at 8% per annum?

* Note.—If you would have your savings account earn the maximum amount of interest, observe these three rules:

(1) Make your deposits in whole dollars before the 5th of each month. Why?

(2) In the first week of January and July, add enough to the interest to make the next dollar. Why?

(3) Make no withdrawals except at interest periods. Why?

4. A young woman had a balance of $52 in a savings bank on Jan. 1. Her deposits were as follows: Feb. 12,

$10; Mar. 3, $15; May 1, $20; June 1, $5. What was her balance on July 1 if interest at 4% per annum, payable semi-annually, is allowed?

5. A young man owns some Liberty Bonds. He put all the interest from them into his savings account at 4% per annum, payable Jan. 1 and July 1. These were the amounts of interest he collected in a certain year:

Mar. 15,	$ 8.50	Sept. 15,	$ 8.50
Apr. 15,	4.25	Oct. 15,	4.25
May 15,	17.00	Nov. 15,	17.00
June 15,	4.00	Dec. 15,	4.00

How much interest did his Liberty Bond interest earn for him that year?

Compound Interest

In your study of savings accounts you found that banks added the interest at certain periods, usually Jan. 1 and July 1, to the balance of the account at those periods. Interest for the next period was computed on this sum. In other words, interest was allowed on the principal and on the interest due.

This kind of interest is called compound interest. Adding the interest due at a certain period to the principal and computing interest on this sum is called compounding interest. Interest may be compounded annually (once a year), semi-annually (every six months), or quarterly (every three months). Banks which allow interest on the **checking account** add to the account at the end of the month the interest earned during the month. This is compounding interest monthly.

Compound interest is legal in several states* if specified in the contract. In the rest of the states compound interest cannot be collected, even if called for in the contract. There is no penalty attached to paying compound interest by those who wish to do so for business reasons. If savings banks did not allow compound interest, depositors might draw their interest when due and with it start a new account, which would amount to the same thing as getting compound interest.

Compound Interest Problems

1. This table shows how money increases if compound interest is allowed.

At 3%, interest added annually.

$100 during the first year becomes $103.
(How did we get $103?)

The $103 during the second year becomes $106.09.
(How did we get $106.09?)

The $106.09 during the third year becomes $109.27.
(How did we get $109.27?)

The $109.27 during the fourth year becomes $112.55.
The $112.55 during the fifth year becomes.........
The ....during the sixth year becomes ....

(1) Find the values at the end of the fifth and sixth years in the table.

(2) The compound interest on $100 for 6 years at 3% is $......... less $100.

(3) How much greater is the compound interest which you found in the previous problem than the simple interest for the same time and rate?

* Cal., Iowa, Mo., Mont., Neb., Tenn.

2. Find the compound interest for 2 years on $200 at 4% per annum payable semi-annually.

Hint.—At the end of the first 6 months, the $200 would be $204. At the end of the first year the $204 would be $208.08. At the end of 1½ years the $208.08 would be........, etc. The compound interest for 2 yr. = the amount at the end of the second year less $200.

Persons who must compute compound interest often do so by means of a table, a part of which is shown here.

Compound Interest Table

Interest Period	Rate of Interest for the Period						
	1%	1½%	2%	2½%	3%	4%	6%
	Amount of $1.00						
1	1.0100	1.0150	1.0200	1.0250	1.0300	1.0400	1.0600
2	1.0201	1.0302	1.0404	1.0506	1.0609	1.0816	1.1236
3	1.0303	1.0457	1.0612	1.0769	1.0927	1.1249	1.1910
4	1.0406	1.0613	1.0824	1.1038	1.1255	1.1699	1.2625
5	1.0510	1.0772	1.1041	1.1314	1.1593	1.2167	1.3382
6	1.0615	1.0934	1.1262	1.1597	1.1941	1.2653	1.4185
7	1.0721	1.1098	1.1487	1.1887	1.2299	1.3159	1.5036
8	1.0829	1.1265	1.1717	1.2184	1.2668	1.3686	1.5938
9	1.0937	1.1434	1.1950	1.2489	1.3048	1.4233	1.6895
10	1.1046	1.1605	1.2190	1.2801	1.3439	1.4802	1.7908

How to Construct the Table

1. The amount for each succeeding period is found by computing the interest at the given rate on the last known amount and adding the interest found to this amount.

The amount for the 9th period at 1% is $1.0937. The interest for the next period (10th) is 1% of this amount, which is $.0109. The amount for the 10th period = $1.0937 + $.0109 = $1.1046.

2. Make the table for the 11th period; for the 12th.

How to Use the Table

1. If the interest is compounded annually at 6% the amount due at the end of 5 years is found by looking in the 6% column opposite the figure 5 in the period column. This amount ($1.3382) − $1.00 is $.3382, the compound interest on $1 at 6% for 5 years. How would you find the compound interest for $500 at 6% for 5 years?

2. If the interest is compounded semi-annually, take half of the given rate and twice the number of years and proceed as if the interest were compounded annually.

Find the compound interest on $1 at 4% for 5 years compounded semi-annually. Look in the 2% column opposite 10 in the period column. The amount is $1.2190. $1.2190 − $1.00 = $.2190, compound interest of $1 for 5 yr. at 4% compounded semi-annually.

3. If the number of periods is greater than 10, the largest shown in the table, find the amount of $1.00 for 10 periods at the given rate; then find the amount for the remaining time at the same rate and multiply these two amounts together. The product is the amount of $1.00 for the entire time.

The amount of $1 at 3% for 15 years compounded annually is $1.5580. Prove this result by multiplying 1.3439 (10 period amount) by 1.1593 (5 period amount).

4. If the time contains a fraction of an interest period, add to the amount for the last full period, such a part of the interest for the next full period as is indicated by the fraction of the time period.

The compound amount of $1 at 6%, compounded annually, for $2\frac{1}{2}$ years is $1.1236 + $\frac{1}{2}$ of ($1.1910 − $1.1236), which is $1.1573.

Practice in Using the Compound Interest Table

1. A boy saved \$100 during 1909. On Jan. 1, 1910, he invested this money at 3%, compounded annually. What was the amount of his investment on Jan. 1, 1920?

2. Some 8th grade pupils bought in Jan., 1920, War Savings Stamps at \$4.12 each. On Jan. 1, 1925, the United States Government will pay \$5.00 for each of these stamps. Some time later the teacher said to the pupils, "You are receiving on your stamp investment 4% interest, compounded annually for 5 years." Use the interest table to test the accuracy of this statement.

3. In July, 1920, some of the pupils mentioned in the previous problem bought War Savings Stamps at \$4.19 each. These stamps are worth \$5.00 each on Jan. 1, 1925. Use the table to find out if this investment pays 4% interest, compounded annually.

4. Can you solve the previous problem without using the table? Try it. Compare the two solutions.

5. A teacher in Nov., 1920, bought 5 War Savings Stamps at \$4.22 each. These stamps are worth \$5.00 each on Jan. 1, 1925. Find out if the buyer made a 4% interest investment, compounded annually.

6. Which will pay more, and how much, \$100 at 3% for 20 years at simple interest or \$100 at $2\frac{1}{2}$% for 20 years, compounded annually?

7. A thrifty young man invested on Jan. 1, 1916, \$300 in a business paying 4% interest, compounded annually. At the time of each interest payment except the last he added \$300 to his investment. What was due 1/1, 1921?

CHAPTER XI

INVESTMENTS

While a person is accumulating savings, he should be studying the problem of how his savings may be made to earn more money; in other words, he should be learning how to invest money. To do this wisely one must know about investments. It is the purpose of this chapter to give you some knowledge of investments, how to judge them correctly, and how to make them wisely.

A perfectly **safe** investment usually earns a low rate of interest. Do you see why? War Savings Stamps and United States Government bonds belong to this class.

A **good** investment yields a higher rate of interest than the class just mentioned, but the element of risk is somewhat greater. The bonds of cities, counties, and states; district drainage bonds; and promissory notes secured by mortgage, or by deed of trust, are examples of this type of investment.

Investments which offer a high rate of interest (say 10% or 12%) are to be regarded with suspicion by the person with small savings. Examples of this type are oil stocks and mining stocks. Transactions in such stocks should more properly be called speculations.

In general a high rate of interest usually means a large risk; a low rate of interest means a small risk. A first class investment can also be readily converted into cash in case of emergency.

Judging Investments

Which of the following investment advertisements do you think offers the safest place for your money? Which the next safest? Which the least safe? Why?

1. "Thrift is Power." "Save and Succeed."
Keep on Buying War Savings Stamps.
Series of 1920

On January 1, 1925, the United States Government will pay $5.00 for each War Savings Stamp sold in 1920 at the following prices: Jan., $4.12, Feb., $4.13; March, $4.14; April, $4.15; etc.

2. "Nothing Venture, Nothing Gain."

Oil has made many fortunes over night, why not yours?
The Money-back Oil Co.

Stock now only 10¢ a share. Get in early before the price advances.

3. "Bonds as Safe as Our Cities."

Municipal bonds yielding 4% to 5% fulfill these tests for successful investing. These bonds are

(1) Safe.—Payment of principal and interest are assured when they are due.

(2) Marketable.—They can be readily sold at any time.

(3) Productive.—The interest yield is as high as is consistent with safety.

4. *Individual loans* secured by residences, apartments, and small business properties in Chicago, in amounts from $2000 to $20,000. Interest yield, 5% to 6%.

5. 6 percent $500 and $1000 denomination 1st Mortgage Serial Gold notes. Interest payable semi-annually. Secured by First Mortgage on Cleveland, Ohio, real estate of more than double value.

Consult the newspapers and magazines for investment opportunities and bring to class what you think are examples of poor, good, and excellent investments.

Mortgages on Real Estate

The oldest investment in the world is the first mortgage loan on land. The Babylonians invented mortgages more than 2500 years ago. Clay tablets unearthed and translated by scholars show that the mortgage in all essentials was the same then that it is now:

(1) A definite promise to pay at a designated time and place a certain sum of money bearing a specified rate of interest.

(2) A definite pledge of real estate as security to guarantee prompt payment of principal and interest.

Much real estate in the United States is pledged as security for mortgage loans. It was recently estimated by a committee of the American Bankers Association that more than $6,000,000,000 in mortgages are held by savings banks and insurance companies in this country, and a total of $10,000,000,000 is held by institutions and individuals as investments.

Mortgages are popular investments because as a class they yield a higher rate of interest than other investments with the same element of risk. Also in time of financial panic they are free from wide fluctuation in value.

Safety factors to be observed when negotiating a first-mortgage loan.

1. The loan should not exceed 50% of the cash value of the real estate pledged as security.

2. If buildings are part of the security, they should be insured in favor of the owner of the mortgage.

3. All back taxes against the property should be paid.

4. The property should be free from debt.

5. The mortgage should be promptly offered to the proper official for record.

Problems about Mortgage Loans

1. A man owned a \$2700 mortgage, bearing 6% interest, on a house on Lafayette Avenue; a \$3000 5% mortgage on Olive Street; and an \$8000 mortgage, earning $5\frac{1}{2}$% interest on Julian Avenue. How much was his average monthly interest income on these three investments?

2. When James Stewart was 21 years old, he had saved \$500. He lent this sum for five years at 6% interest per annum, payable annually, to John Smith, a young farmer, who owned 60 acres of land, free from debt, valued at \$4000. Mr. Smith gave as security for his note a mortgage on this land.

(1) Who was the borrower in this transaction?

(2) Who was the lender? Who signed the mortgage?

(3) Who kept the note? Who kept the mortgage?

(4) What was the face of the note?

(5) When was the interest due? How much?

(6) Write the note described in the problem.

(7) Do you think this was a good investment for Mr. Stewart? Why?

3. After owning for 3 months the note described in problem 2, Mr. Stewart sold it to Levi Miller for \$540.

(1) How much of the selling price of the note was earned interest? How much was premium?

(2) When did Mr. Miller get his first interest?

(3) Did Mr. Miller realize 6% on his investment? Why?

(4) What did Stewart do before Miller could become the legal owner of the note?

You have probably observed in your newspaper and magazine reading that the business of manufacturing, mining, shipping, and merchandising is carried on chiefly by companies or corporations. Find the names of several companies (1) in your community, (2) in your magazine or newspaper.

Corporations are authorized by the state to transact business just as individuals. The rights, duties, and privileges are stated in a document, called a **charter,** which is granted by the state to the corporation.

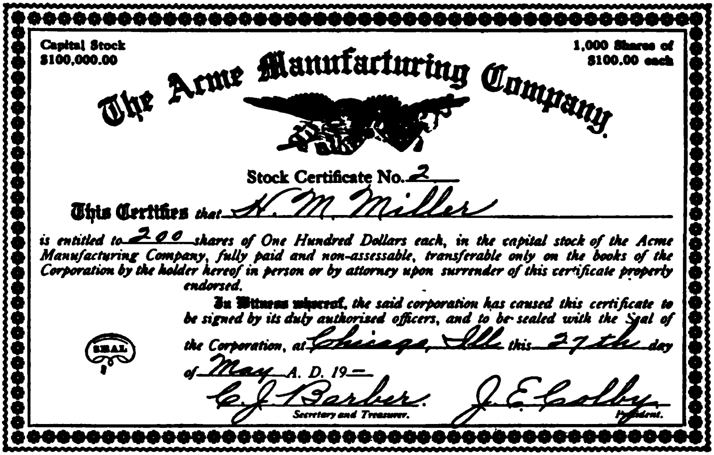
The members of the corporation elect from their number several persons (often five), called a **board of directors.** This body transacts the important business of the corporation. The less important business is transacted by the officers of the board, usually consisting of a president, a secretary, and a treasurer.

The capital used in the business is called **stock.** The owners of the stock are called the **stockholders.** The stock is divided into a certain number of equal parts, called **shares.** The face value of a share, called par value, is usually $100, although mining and oil companies often issue shares of $1 each. (Do you see any reason why?)

If the capital stock is $25,000, divided into shares of $100 each, there are 250 shares.

The instrument which is given the owner of stock is called a **stock certificate, or stock.** Study the form on the next page and find out how such a certificate differs from a promissory note.

The amount of money to be distributed from the earnings of a company among the owners of common stock is



Capital Stock
$100,000.00

1,000 Shares of
$100.00 each

The Acme Manufacturing Company

Stock Certificate No. 2

This Certifies that H. M. Miller

is entitled to 200 shares of One Hundred Dollars each, in the capital stock of the Acme Manufacturing Company, fully paid and non-assessable, transferable only on the books of the Corporation by the holder hereof in person or by attorney upon surrender of this certificate properly endorsed.

In Witness whereof, the said corporation has caused this certificate to be signed by its duly authorized officers, and to be sealed with the Seal of the Corporation, at Chicago, Ill. this 27th day of May A. D. 19—

SEAL

C. J. Barber
Secretary and Treasurer.

J. E. Colby
President.

CERTIFICATE OF STOCK

determined by the board of directors. The money so distributed is called a **dividend.** The **rate of dividend** is always computed on the par value. Thus a 6% dividend means 6% of the par value, whether this be $100, $50, or $1 per share.

The **market value** of a stock is the price it brings as a purchase, or as a sale. If a man pays $80 for a $100 share, the market value is $80. This value may fluctuate from day to day or even during the same day. Newspapers always quote the market value.

Companies sometimes issue two kinds of stock, called **common** and **preferred.** Preferred stock has the dividend rate fixed in the stock certificate. This dividend must be set aside from the earnings of the company before a dividend on the common stock can be distributed.

Brokerage

A broker is an agent who buys or sells for the owners. The compensation which he receives is called brokerage. This is usually a certain sum for each share of stock bought or sold.

It is the custom of the New York Stock Exchange, followed by many others, to allow the broker $12\frac{1}{2}$¢ per share for buying or selling any stock which brings \$10 or more per share and $6\frac{1}{4}$¢ per share for stock whose market value is less than \$10.

Thus, the brokerage for selling 100 shares of Mo. Pacific R. R. stock (par value \$100) at \$$25\frac{5}{8}$ per share is $100 \times 12\frac{1}{2}$¢, and for selling 100 shares of M. K. & T. R. R. stock (par value \$100) at \$$9\frac{1}{4}$ per share is $100 \times 6\frac{1}{4}$¢.

When brokerage is expressed in per cent it is computed on the par value.

Problems about Stocks

1. On a certain stock certificate is found this statement "Capital 1000 shares of \$100 each." Express the capital in dollars.

2. How many shares of \$100 each in a company's capital of \$1,000,000?

3. A man owns 10 shares of bank stock. On his stock certificate is the statement: "Capital \$60000; shares \$100 each." What % of the capital stock does he own?

4. How much must you pay, including brokerage, for 10 shares of United Railway stock when it is quoted at \$8.25?

5. How much in money is a 6% dividend when the par value is \$100? \$50? \$1?

6. What is the probable effect of a high dividend rate on the market value? Why?

How to Read the Stock Market

Table I shows the prices of certain stocks during the day, the change over the preceding day, the last quotations at the close, the net change, and the number of shares sold on the Stock Exchange at New York City on Aug. 5, 1918.

TABLE I

Sales	Name of Stock	Prev. Close	Open	High	Low	Close	Net Change
400	Balt. and O. . .	54	$54\frac{1}{8}$	$54\frac{3}{8}$	54	54	0
200	do* preferred	57	57	57	57	57	0
200	Colo. Fuel & Iron	45	$45\frac{1}{8}$	$45\frac{1}{8}$	45	45	0
500	Mo. Pacific . .	$23\frac{3}{8}$	$23\frac{1}{4}$	$23\frac{1}{8}$	$23\frac{1}{8}$	$23\frac{1}{8}$	$-\frac{1}{4}$
300	Norfolk & Western	103	103	$103\frac{1}{2}$	103	$103\frac{1}{4}$	$+\frac{1}{4}$
600	Wabash	$9\frac{1}{4}$	$9\frac{1}{2}$	$9\frac{1}{2}$	$9\frac{1}{4}$	$9\frac{1}{4}$	0
100	Woolworth . .	$112\frac{1}{2}$	111	111	111	111	$-1\frac{1}{2}$

The first line of this table is to be read as follows: On August 5, 1918, there were sold on the New York Stock Exchange 400 shares of common stock of Baltimore and Ohio Railroad. The first sale (called "Open" in the table) was made at $\$54\frac{1}{8}$ per share; the highest price was $\$54\frac{3}{8}$; the lowest price was \$54, which was also the price of the last sale of the day (called "Close" in the table). Net change means the difference in price between the last sale of the day and the last sale of the previous day. In Baltimore and Ohio there was no **net** change, although the price **fluctuated during the day.**

*The second line means this: There were sold 200 shares of Baltimore and Ohio preferred stock (***do** means **the same**) at \$57 per share, there being neither net change **nor** fluctuation during the day.

Tell the meaning of the rest of Table I.

Table II shows the sales and prices on Dec. 24, 1919, of the stocks listed in Table I. It is to be interpreted exactly as Table I was interpreted.

TABLE II

Sales	Name of Stock	Prev. Close	Open	High	Low	Close	Net Change
6400	Balt. and Ohio.	32	32	$32\frac{5}{8}$	$31\frac{3}{4}$	$32\frac{1}{4}$	?
1200	do preferred	$46\frac{1}{2}$	46	46	$45\frac{1}{4}$	$45\frac{1}{4}$	?
200	Colo. Fuel & Iron	40	$39\frac{5}{8}$	40	$39\frac{5}{8}$	40	?
1000	Mo. Pacific	$25\frac{3}{4}$	$25\frac{5}{8}$	$25\frac{7}{8}$	$25\frac{1}{2}$	$25\frac{3}{4}$	?
1400	Wabash	$8\frac{1}{8}$	$8\frac{1}{8}$	$8\frac{3}{8}$	8	8	?
100	Woolworth	$121\frac{3}{8}$	122	122	122	122	?

1. Find the amount of net change for each stock.

2. Tell the meaning of Table II for each stock.

3. Look on the market page of your newspaper for the quotations on the stocks listed in this table.

Problems Based on Tables I and II

1. Name the stocks in Table I which sold at a discount (below par). Name those which sold at a premium (above par).

2. Which stock sold at a premium in Table I and is not listed in Table II?

3. Name the stocks which made a plus net change in Table II.

4. Find the total sales in shares in Table I.

5. Compute the ratio between the total shares sold in Table II and those sold in Table I.

6. A man invested \$5000 in Missouri Pacific Railroad stock at $25\frac{5}{8}$, plus $12\frac{1}{2}$¢ brokerage. How many shares did he buy and how much money had he left?

7. How much money was sent to the owner by the broker who sold 1000 shares of Norfolk and Western Railroad stock at $98\frac{1}{4}$?

8. What was the total cost to the man who bought 200 shares of Balt. and O. stock at 54 on Aug. 5, 1918, plus brokerage at $12\frac{1}{2}$¢ per share?

9. If the buyer in problem 8 sold his stock on Dec. 24, 1919, at $32\frac{5}{8}$, less brokerage, find his total loss.

10. If Balt. and O. stock paid no dividend for 1918 and 1919, what additional loss did the owner of such stock sustain?

11. Compute the loss of the man who bought 300 shares of Wabash at $9\frac{1}{2}$ and sold it at $8\frac{3}{8}$, brokerage $6\frac{1}{4}$¢ per share in each transaction.

12. Compute the gain of the owner of 100 shares of Woolworth stock if it was bought at its lowest price in Table I and sold at the highest price in Table II. Do not omit brokerage.

13. Some persons think that stock transactions should be classed as speculations rather than as investments. Do you now see why they think so?

14. Select five stocks from your daily paper and keep a daily record for a week of the net change of each. At the close of the week express your results in 5 suitable graphs.

How to Compute the Rate of Income

In the case of stocks the amount of the dividend on each share is also the income on a share.

The dividend = par value × rate of dividend.

The rate of income is the per cent which the income is of the purchase price (market value at the time the stock was bought).

This formula is helpful in solving certain stock problems.

Par value × rate of dividend = market value × rate of income.

Problem.—When 6% stock is selling at 120, find the rate of income. $6 is the income produced by each share. To get this income the buyer paid $120. The problem then becomes an easy one in percentage. "$6 is how many per cent of $120?"

Proof.—$100 (Par) × 6% (Rate of dividend) = $120 (Market) × 5% (Rate of income).

The formula also helps to solve this type of problem: "What may be paid for a 6% stock to make 8% on the purchase price (market value)?"

Solution.—A 6% stock yields $6 income on each share. The problem then becomes "$6 is 8% of what amount?" $6 is 8% of $75 (market value).

Proof.—$100 (Par) × 6% (Rate of dividend) = $75 (Market) × 8% (Rate of income).

Problems

1. When U. S. Steel 7% stock was selling at 105, was the rate of income more or less than 7%? Why?

2. When 4% railroad stock sold at 85, was the rate of income as much as 5%? At what price must this stock be bought to earn exactly 5% income?

3. When a certain bank stock was selling at 115, its dividend rate was 10%. Find the rate of income.

4. In 1920, the bank stock mentioned in problem 3 sold at 150. What was the rate of income at this price?

5. If a buyer is satisfied with a 5% income on a 10% bank stock, what can he afford to pay for the stock?

COUPON BOND

UNITED STATES OF AMERICA

FIRST MORTGAGE 5/25 SINKING FUND GOLD BOND.

OF THE

CITIZENS STREET RAILWAY COMPANY

A CORPORATION UNDER THE LAWS OF MICHIGAN.

TOTAL AUTHORIZED ISSUE $250,000

1000

For Value Received the Citizens Street Railway Company established in the City of Kalamazoo in the County of Kalamazoo and State of Michigan promises to pay the bearer, or if registered, to the registered holder, the sum of One Thousand Dollars in gold coin of the United States of the present standard of weight and fineness at the office of the Illinois Trust and Savings Bank, Trustee in the city of Chicago Illinois in Twenty Five Years from the date hereof (or on call at or after the expiration of five years from date, with a specified premium as hereinafter provided) with interest on said sum at the rate of six per cent per annum, payable semi-annually in like gold coin on the first days of May and November in each year at the office of said Illinois Trust and Savings Bank [illegible] of Chicago Illinois [illegible] to the [illegible] of the coupons hereto attached, upon presentation and surrender thereof respectively.

This Bond is one of a series of Two hundred and fifty bonds for One Thousand Dollars each, amounting in the aggregate to Two hundred and fifty Thousand Dollars numbered consecutively from 1 to 250 inclusive all bearing even date herewith and [illegible] and in the [illegible] form of Twenty Five Years executed and delivered in [illegible] Street Railway Company authorizing the issue of said bonds and the execution and delivery of the Trust Deed hereinafter mentioned.

$1000

Payment of this bond and of the coupons attached is secured by a Trust Deed of even date herewith (which is hereby referred to and made a part of this bond) embracing all the property, assets and franchises (both present and future acquired) of said Citizens Street Railway Company, executed and delivered by it to said Trustee. Said Trust Deed (which has been duly recorded and filed both as a mortgage on real estate and as a chattel mortgage) is in the possession of said Trustee open to examination by any party having any interest therein.

This bond may at the option of the Obligor be redeemed at or after the expiration of five years from the date hereof and before maturity by payment in gold coin as aforesaid of one thousand and twenty dollars ($1020) together with all interest accrued to the time of such payment and unpaid, due notice of the call therefor having first been given by publication as required by the terms of said Trust Deed.

This bond shall not be valid unless the certificate endorsed hereon shall bear the signature of the Trustee.

In Testimony Whereof said Citizens Street Railway Company has caused these presents to be signed in its behalf by its President and its corporate seal to be hereto affixed and attested by its Secretary, and the attached coupons each to be authenticated by an engraved fac-simile of its Treasurer's signature this first day of November A.D. Eighteen Hundred and Ninety Three.

Citizens Street Railway Company

Attest ______ By ______ President

______ Secretary

$30.00 THE CITIZENS STREET RAILWAY COMPANY $30.00 — THIRTY DOLLARS — coupons No. 50, 49, 48, 47, 46, 45, 44, 43, 42, 41

Note.—The above form shows only the last ten of the fifty coupons originally attached. This is a 25-year bond, with two interest coupons falling due each year.

Bonds

1. National, state, county, and city government, and other corporations sometimes borrow money to meet certain expenditures. This may be done by selling bonds.

2. A bond is a promise under seal by a corporation to pay a certain sum of money at a specified time.

3. Study the picture of the coupon bond on page 286 to discover (1) in how many ways it is like an ordinary promissory note; (2) in how many ways it is different.

4. Write the resemblances and differences.

5. Bonds may be issued in any denomination, but the usual size is $1000, $500, or $100.

6. Bonds usually have a long time to run, such as 15, 20, or 30 years.

7. Turn to page 280, and read carefully once more a stock certificate.

8. Write at least three important ways in which the bond on page 286 differs from the stock certificate just read.

9. Some pupils find five important differences. Can you?

10. Study the interest note (coupon) on this page. Then answer these questions.

(1) How often is the interest due?

(2) What is the face of the bond from which this coupon was cut?

(3) If you were the owner of this coupon, how would you get payment for it? When?

(4) What care must be taken of coupon bonds?

THE UNITED STATES OF AMERICA will pay to bearer on March 15, 1922, at the Treasury Department, Washington, or at a designated agency, $1.06, being six months' interest then due on a $4\frac{1}{4}\%$ $50 Coupon Bond of the Third Liberty Loan.
1379535

Register of the Treasury.

Buying Bonds

1. Bonds are bought and sold through brokers. Your banker can also obtain them for you.

2. Why may it be better for the small investor to buy his bonds from his banker?

3. Young investors should early make the acquaintance of the local banker. Why?

4. The brokerage, premium, and discount are computed on the par value (face value).

5. Interest on bonds is due at intervals named in the bond.

6. When bonds are bought between interest dates, the buyer pays the interest earned to the day of purchase. This is called **accrued interest** and it comes back to the owner of the bonds at the next payment of interest.

7. On Nov. 27, 1920, $4\frac{1}{4}\%$ Third Liberty Loan bonds were quoted at $88.50. This means that the buyer must pay $88.50 for a $100 bond, also the interest on $100 at $4\frac{1}{4}\%$ from Sept. 15, 1920, to Nov. 27.

8. Counting the actual days how much is the accrued interest in problem 7? Why is it right for the buyer to pay this accrued interest?

9. How much money did I pay on Nov. 27 for three $100 bonds based on the quotation in problem 7, omitting the brokerage?

10. Find the cost of ten one thousand dollar U. S. 2's when quoted at 98, allowing $\frac{1}{8}\%$ brokerage, if bought immediately after the interest is due.

11. Make and solve five problems based on the price of Liberty Loan bonds at the time you are studying this page.

12. On Dec. 24, 1919, $4\frac{1}{4}\%$ Fourth Liberty Loan bonds were quoted at $91.40. The last interest payment on these bonds was Oct. 15, 1919. How many $100 bonds, brokerage $\frac{1}{8}\%$, could have been bought with $5050 and how much money was left?

HINT.—Remember that the total amount paid for one bond is a sum of three addends.

13. With the money remaining in problem 12, how many $50 Fourth Liberty Loan bonds could have been bought on Dec. 24? How much money remained? How might the money left have been safely invested?

14. Consult a newspaper which contains the bond market and find out how many $50 Liberty Loan bonds described in problems 12 and 13 you can buy for $5000 at the time you study bonds at school.

Finding the rate of interest bonds earn for the buyer, assuming that the bonds are held until maturity and that the face value is paid at that time.

1. The bond interest is the interest **named** in the bond.

2. The buyer's interest is the interest **earned** by the bond. It may be equal to, less, or greater than the bond interest, accordingly as the bond is purchased at par, at a premium, or at a discount.

3. If a 5% $100 bond, due in 6 years, is selling at 104, the total bond interest for 6 yr. is $6 \times \$5$, whereas the interest (income) actually earned by the investment is $30 less $4 (premium), or $26, because the bond at maturity is paid at par value.

4. If a 5% \$100 bond due in 3 yr. is bought at 98, the total bond interest is $3 \times \$5$, but the total interest (income) actually earned is \$15 and \$2 (discount), or \$17.

5. The rate of interest a bond earns for its buyer is based on the amount paid for the bond, exclusive of accrued interest which is returned to the owner at the time he receives his first interest.

6. In problem 3 the actual interest earned in 6 yr. by an investment of \$104 is \$26. The interest earned in 1 yr. is $\$26 \div 6$, or $\$4\frac{1}{3}$. Consequently the rate of interest the buyer actually gets is $\$4\frac{1}{3} \div \$104 = 4.16+\%$.

7. If the reasoning in problem 6 is employed on the bond in problem 4, the rate of interest to the buyer $= \dfrac{\$17 \div 3}{\$98}$

$$= \frac{\$5\frac{2}{3}}{\$98} = 5.78+\%.$$

8. The next formula will be found convenient in solving bond problems.

Par value + Bond interest = Market value + Buyer's interest.

9. What rate of interest do 6% bonds yield, due in 7 years, if bought at 108?

$\$100 + \$42 = \$108 + \$x$(Buyer's interest). See formula in number 8. $\$x = \$34$.

Rate of interest yielded to buyer $= \dfrac{\$34 \div 7}{\$108} = 4\frac{1}{2}\%$ nearly.

NOTE.—In the above computation simple interest is used. Bankers use tables in which the principle of compound interest is employed. On bonds with a short time to run, the difference between the two methods is very small. For all practical purposes the ordinary bond buyer may use the method indicated above.

10. When Third Liberty Loan $4\frac{1}{4}\%$ bonds had exactly 9 years to run until due, they were quoted at 93.20. Omitting brokerage, find the buyer's rate of interest.

11. If 6% bonds selling at 112 have exactly $15\frac{1}{2}$ years to run, determine the buyer's rate of interest.

12. When U. S. 4's were selling at 106, 7 years and 3 months before maturity, what was the rate of interest to the buyer?

13. On Nov. 29, 1919, a United States Treasury certificate, worth $100 on Jan. 1, 1924, was purchased for $84.40. Some people said that at this price the investment was earning 4.27% compound interest, compounded yearly; others said the rate of interest earned was only $4\frac{1}{4}\%$ compounded yearly. Use your knowledge of compound interest to see which statement is correct.

14. By use of the compound interest table on page 272, determine whether a $1000 United States Treasury certificate due Jan. 1, 1925, purchased Jan. 1, 1920, for $824, earns as much as 4% interest, compounded yearly.

15. What rate of simple interest are Third Liberty Loan bonds earning the buyer on the day you are studying this page?

16. Compute the rate of interest earned by Fourth Liberty Loan bonds if they are bought at the current price.

Why We Should Want to Own Good Bonds

1. United States Government and many municipal bonds are the safest investment that can be made. There may be others just as safe, but none safer.

2. The interest is paid promptly at the time it is due.

3. They can be bought in small denominations.

4. They are good security at banks if the owner needs to borrow money for a short time.

5. There is always a cash market for them. This is advantageous both to buyer and seller.

6. In the case of registered bonds the interest is sent to the owner.

7. To the person with a small income, United States bonds are free from all tax.

8. Their depreciation (loss in market value) is likely to be less than that of most other property.

How Bonds and Stocks Differ

1. Bonds are promises to pay a certain sum of money at a definite time. Stock certificates are merely evidence of ownership.

2. The amount of interest and the time of its payment are definitely fixed. Dividends are not certain.

3. The payment of bonds is guaranteed by some form of security. There is no guarantee of any kind in a stock.

Why Persons with a Small Income Should not Buy Stocks for Investment

1. The market value of most stocks fluctuates widely.

2. Dividends are not certain.

3. The rate of dividend is not fixed except in preferred stocks. Even in this case it is not guaranteed.

4. The speculative factor is too large.

1. A farmer bought a horse on Apr. 1 for \$175. On Oct. 1 he sold him for \$200. If the work done by the horse paid for his board, and if money was worth 6% to the farmer, find the per cent of profit on the selling price.

2. In 1918 a certain level Ohio farm averaged 23 bu. of wheat per acre, valued at \$2.15 per bu. The following items show the acre cost of growing wheat on this farm:

Plowing, 7 hr. @ 60¢;
Harrowing and disking, 5 hr. @ 60¢;
Seed, 2 bu. @ \$2.15; fertilizer, 250 lb. @ \$20 per ton;
Interest on the above labor and expense at 6%, \$.84;
Interest on 1 acre of land valued at \$150 at 6%;
Harvesting and threshing, \$3.30;
Delivering to market 1 mile away, \$.60.

Determine the profit per acre on this farm. Is growing wheat a profitable farm practice under these conditions? Is there any item of cost omitted in the statement above?

3. If the farm were hilly and located 7 miles from market, how would the cost items vary in the previous problem?

4. A certain Ohio farmer in 1918 raised 5 acres of potatoes averaging 110 bushels per acre. He sold them at \$1.25 per bushel. It required 14 bushels of seed potatoes valued at \$1.50 per bushel for planting an acre. Materials for spraying cost \$1.60 per acre. The labor per acre was estimated at 45 hr. (man and team) at 75¢ per hr. The cost of picking up and sacking was \$2.25 per acre. What was the gross profit per acre? What was the farmer's net profit on 5 acres after deducting interest @ 6% on land valued at \$120 per acre, also interest @ 6% for 3 mo. on his labor and expense, and a $1\frac{1}{2}$% tax on a tax valuation of \$90 per acre?

Problems About Real Estate

1. If you have \$7200 to invest, which will be the better proposition, lending it at 6% interest, or buying a small business property which rents for \$55 a month? Allow \$125 a year for repairs, \$40 for insurance, and \$70 for taxes.

2. A man bought for \$7000 a storehouse, which he rented for \$40.00 a month. He paid annually \$65 for repairs, \$50.00 for taxes, and \$35.00 for insurance. At the end of two years he sold the property for \$7500. Did he make more, or less, than he would have made by putting his money into a savings bank, which pays 4% interest, compounded semi-annually?

3. I paid \$4000 for a house and lot. The taxes are \$45 per year, and other yearly expenses are estimated at \$60. What rent must I charge per month to make 6% interest on the cost of my property, if the house is vacant on an average $8\frac{1}{3}$% of the time?

4. A man paying \$60 a month house rent has \$4000 in a savings bank. The bank pays him 4% interest per annum, compounded semi-annually. Will he save, or lose money by buying a house for \$10,000 with the \$4000 cash and a 6% note for the balance, if taxes on the house are \$115 a year and repairs and other expenses are \$100? How much?

5. James Forest has \$1250. He can lend it to Alfred Wood for one year at 6%, or he can purchase with it a farm mortgage running 3 years and bearing $5\frac{1}{2}$% per annum. What would be Mr. Forest's income in each case from his investment? State in writing all the reasons you can think of why he should prefer the farm mortgage.

1. In Texas the legal rate of interest is 8%. In Ohio it is 6%. How much greater is the Texas rate than the Ohio rate? What per cent greater?

2. In the window of a bank of a large city is found this statement, "We pay 4% per annum on your savings." Across the street in another bank's window is found this statement, "We pay 25% more." What does this mean?

3. A young man on July 10, 1912, bought 10 shares of bank stock (par value $100) at $115 per share, no brokerage. This stock paid a 10% dividend each year, $\frac{1}{2}$ paid Jan. 1 and $\frac{1}{2}$ paid July 1. He owned this stock Jan. 15, 1920.

(1) What rate of income was realized by the owner?

(2) What amount in dividends was paid to the owner?

(3) The owner of this stock placed each dividend, as soon as it was received, into the savings bank at 4% simple interest. How much had the dividends earned for him in this manner on Jan. 1, 1920?

HINT.—The first dividend, $50, was deposited Jan. 2, 1913. The second was deposited before July 5, 1913. Each dividend was deposited on or before the 4th of the month in which it was due.

(4) On Jan. 20, 1920, this stock was sold at $140 per share. What was the rate of profit?

(5) What was the rate of income to the new owner?

4. In July, 1899, a teacher bought a $1000 5% Florence, Ala., bond, interest payable semi-annually. How much interest had this investment earned for the owner when the bond was paid, Jan., 1919, if the owner re-invested each interest coupon of $25.00 at 4% the day it was due?

Investing in a High School Education

The Federal Bureau of Education at Washington has found out that boys leaving school at 14 receive an average weekly wage of $4; at 18 these boys receive an average of $7 a week; at 20 they get an average of $9.50 per week; at 25 they get an average of $12.75 per week. The average total wages at 25 for such boys are $5,112.50.

The boys who stop school at 18 to begin work get on an average $10 per week; at 20 they get $15; and at 25 they are getting $31. The average total earned for such boys at 25 is $7,337.50.

1. Construct graphs showing the average weekly wage of the two groups at the ages named.

2. Find the ratio of the total wages at 25 of the boy who remained in school till 18 to the total wages of the one who quit at 14.

3. Was the additional time spent in school a good investment?

4. Which of these groups will first reach the limit of their earning power? Why?

5. What opportunities may the high school boy have at 25 years of age, or older, which probably would never come to the boy who quit school at 14?

6. Would it be a good investment for a young person without means to borrow from some friend $100 a year, at 6% simple interest, for four years in order to go to high school?

CHAPTER XII

TESTS

This is the Rice test given in 1902 to 689 8th grade children. The average achievement (right answers) for the best class was 91.7%; for the poorest class it was 11.3%; the average for all the classes was 49.4%.

Try to solve 7 right in 50 minutes.

Find out if your class stands above or below the average.

1. The salt water which was obtained from the bottom of a mine of rock salt contained 0.08 of its weight of pure salt. What weight of salt water was it necessary to evaporate in order to obtain 3,896 pounds of salt?

2. If a map 10 inches wide and 16 inches long is made on a scale of 50 miles to the inch, what is the area in square miles that the map represents?

3. A gentleman gave away $\frac{1}{7}$ of the books in his library, lent $\frac{1}{6}$ of the remainder, and sold $\frac{1}{5}$ of what was left. He then had 420 books remaining. How many had he at first?

4. Gunpowder is composed of nitre 15 parts, charcoal 3 parts, and sulphur 2 parts. How much of each in 360 pounds of powder?

5. The insurance on $\frac{2}{3}$ of the value of a hotel and furniture cost $420. The rate being 70 cents on $100, what was the value of the property?

6. Steel was sold at $27.60 a ton, with a profit of 15%, and a total profit of $184.50. How much was sold?

7. A man sold 50 horses at $126 each. On one-half of

them he made 20 per cent of the cost, and on the other half he lost 10 per cent of the cost. How much did he gain?

8. A fruit dealer bought 300 apples at the rate of 5 for a cent, and 300 at 4 for a cent. He sold them all at the rate of 8 for 5 cents. What per cent did he gain on his investment?

A 1920 Reasoning Test

An 8th grade pupil good in problem solving should have 8 right in 30 minutes. After the test solve those you did not try, also those you missed.

1. I went to a store with a five dollar bill. If the amount of my purchase was $3.69, how much change did I receive?

2. An ocean liner traveled 2012 miles in 8 days. What was the average speed per day?

3. John's growth last year was 2½ inches. This year he grew 2¼ inches. How tall is he now if 2 years ago his height was 4 feet 9 inches?

4. A grocer buys peaches at 16⅔ cents per can. If he sells them at $2.40 per dozen, what is his profit per can?

5. A hod carrier carries 24 brick, weighing 120 pounds, at a load. Find the weight of a single brick.

6. When baseball uniforms are worth $7.50 each and shoes are worth $3.25 per pair, what will it cost to equip a baseball nine with uniforms and shoes?

7. A fruit dealer bought a stalk of bananas, containing 21 dozens, for $7.77. What price did he pay per dozen?

8. A dealer bought 75 bushels of apples at $1.65 per bushel and sold them at $1.75 per bushel. At the same time he purchased 20 bushels of nuts which he sold at a profit of 15 cents per peck. Which purchase proved to be the more profitable, and how much?

9. A grocer received a bill of lading for 300 pounds of sugar costing $37.50. If he was allowed a profit of 10%, what was the selling price per pound?

10. A news boy spent \$1.40 for papers. He sold them for \$2.10, making a profit of one cent on each paper. How many papers did he purchase?

11. I paid \$6000 for a house and lot. If the taxes are \$60 and other expenses \$48 per year, what rent must I charge per month to make 6% interest on the cost of my property?

12. In drying, a pound of apples is reduced to 3.20 ounces by the evaporation of the water in the apples. How many pounds must be prepared for drying in order to have 25 pounds of the dried fruit?

The Reavis Problem Test without Figuring

An 8th grade pupil good in problem solving should write 7 correct answers in 15 minutes. After the test solve those you did not try, also those you missed.

1. A submarine made a voyage of a given number of miles, going a certain number of miles under water and the remainder of the distance on the surface. How would you find the distance traveled on the surface?

2. A grocer received a bill giving the number of pounds shipped and the cost of an order of sugar. If you were given this bill, how would you find the cost of the sugar per pound?

3. If you know the weight of dough required to make a single loaf of bread, how would you find the weight of the dough a baker must prepare to make a given number of similar loaves?

4. A fruit dealer bought a stalk of bananas containing a certain number of dozens for a certain price. How would you find the cost per dozen?

5. If you know the cost of my purchase at a store and the amount I had when I left the store, how would you find the amount of money I had when I went to the store?

6. If you know the number of bricks carried by a hod carrier at a load and the weight of the load in pounds, how would you find the weight of a single brick?

7. A man bought a house and lot for a certain price. He paid a certain amount in cash and gave a mortgage for the rest. How would you find the amount of the mortgage?

8. If you know the number of hours required by a train to go from one city to another and the speed of the train per hour, how would you find the distance between the cities?

9. At a school picnic the patrons gave a treat of ice cream to each child present. If you knew the number of children a gallon of ice cream would serve and the number of children present, how would you find the number of gallons required?

10. A boy earned a given sum last week selling newspapers. He gave a certain part of his earnings to his mother and invested the rest in thrift stamps. How would you find the amount invested in thrift stamps?

Tests In the Fundamental Processes

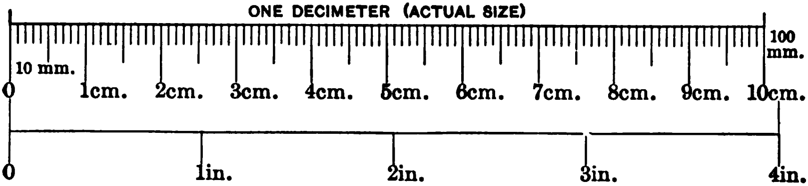
Each of the exercises listed below is a computing test found on a previous page of this book. A good 8th grade pupil should reach the standards stated on this page.

1. Addition of integers, p. 156, ex. X, 7 right, 3 min.
2. Subtraction, p. 157, ex. XV, all right, 5 min.
3. Addition facts, p. 153, ex. I, all right, 1 min.
4. Subtraction facts, p. 154, ex. II, all right, 1 min.
5. Subtraction facts, p. 154, ex. III, all right, $1\frac{1}{2}$ min.
6. Multiplication facts, p. 154, ex. IV, all right, 1 min.
7. Division facts, p. 155, ex. V, all right, 1 min.
8. Short column addition, p. 155, ex. VI, 5 right, 1 min.
9. Short division, p. 156, ex. IX, 4 right, 1 min.
10. Long division, p. 156, ex. XII, 3 right, 3 min.
11. Addition of fractions, p. 156, ex. XIII, 10 right, 3 min.
12. Addition of integers, p. 157, ex. XIV, 12 right, 8 min.
13. Multiplying integers, p. 158, ex. XVI, 11 right, 6 min.
14. Multiplication (all multiplication facts), p. 158, ex. XVII, 6 right, 6 min.
15. Division of integers, p. 158, ex. XVIII, 11 right, 8 min.
16. Use of signs, p. 159, ex. XX, all right, 5 min.
17. Adding mixed numbers, p. 159, ex. XXI, all right, 6 min.
18. Long division, p. 159, ex. XXII, all right, 10 min.
19. Fractions, pp. 160, 161, ex. XXIII, 100 right, 30 min.
20. Dividing of decimals, pp. 162, 163, ex. XXV, 40 right, 10 min.
21. Fractions and percentage, p. 164, ex. XXVII, 40 right, 10 min.
22. Finding averages, p. 164, ex. XXVIII, all right, 10 min.
23. Finding the missing number, p. 165, ex. XXIX, all right, 5 min.
24. All the fundamental processes, p. 165, ex. XXX, all right, 10 min.

A Table of Imperfect Squares, showing the Square Roots to Two Decimal Places

Square	Square Root	Square	Square Root	Square	Square Root	Square	Square Root
2	1.41	40	6.32	75	8.66	110	10.48
3	1.73	41	6.40	76	8.71	111	10.53
5	2.23	42	6.48	77	8.77	112	10.58
6	2.44	43	6.55	78	8.83	113	10.63
7	2.64	44	6.63	79	8.88	114	10.67
8	2.82	45	6.70	80	8.94	115	10.72
10	3.16	46	6.78	82	9.05	116	10.77
11	3.31	47	6.85	83	9.11	117	10.81
12	3.46	48	6.92	84	9.16	118	10.86
13	3.60	50	7.07	85	9.22	119	10.90
14	3.74	51	7.14	86	9.27	120	10.91
15	3.87	52	7.21	87	9.32	122	11.04
17	4.12	53	7.28	88	9.38	123	11.09
18	4.24	54	7.34	89	9.43	124	11.13
19	4.35	55	7.41	90	9.48	125	11.18
20	4.47	56	7.48	91	9.53	126	11.22
21	4.58	57	7.55	92	9.59	127	11.26
22	4.69	58	7.61	93	9.64	128	11.31
23	4.79	59	7.68	94	9.69	129	11.35
24	4.89	60	7.74	95	9.74	130	11.40
26	5.09	61	7.81	96	9.79	131	11.44
27	5.19	62	7.87	97	9.84	132	11.48
28	5.29	63	7.93	98	9.89	133	11.53
29	5.38	65	8.06	99	9.95	134	11.57
30	5.47	66	8.12	101	10.04	135	11.61
31	5.56	67	8.18	102	10.09	136	11.66
32	5.65	68	8.24	103	10.14	137	11.70
33	5.74	69	8.30	104	10.19	138	11.74
34	5.83	70	8.36	105	10.24	139	11.79
35	5.91	71	8.42	106	10.29	140	11.83
37	6.08	72	8.48	107	10.34	141	11.87
38	6.16	73	8.54	108	10.39	142	11.91
39	6.24	74	8.60	109	10.44	143	11.95

NOTE.—For the square root of any number 100 times any number in the table, multiply the root by 10. Since the square root of 27 is 5.19, the square root of 2700 is 51.9. For the approximate square root of any number 10 times any number in the table, multiply the root by $3\frac{1}{6}$. The square root of 33 is 5.74. The square root of 330 is about $3\frac{1}{6} \times 5.74$ or nearly 18.17.



Measures of Length

English

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
5½ yards, or 16½ ft.	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
5280 feet	= 1 mile
1760 yards	= 1 mile
6360 inches	= 1 mile

Metric

10 millimeters (mm.)	= 1 centimeter (cm.)
10 centimeters	= 1 decimeter (dm.)
10 decimeters	= 1 meter (m.)
10 meters	= 1 dekameter (Dm.)
10 dekameters	= 1 hektometer (Hm.)
10 hektometers	= 1 kilometer (Km.)
1 meter	= 40 in. (more accurately 39.37 in.)

Measures of Weight

English (Avoirdupois)

437½ grains (gr.)	= 1 ounce (oz.)
16 ounces (oz.)	= 1 pound (lb.)
100 pounds (lb.)	= 1 hundredwt (cwt.)
2000 pounds	= 1 ton (T.)
2240 pounds	= 1 long ton
196 pounds	= 1 barrel (bbl.) of flour
7000 grains	= 1 pound

Metric

10 milligrams (mg.)	= 1 centigram (cg.)
10 centigrams	= 1 decigram (dg.)
10 decigrams	= 1 gram (g.)
10 grams	= 1 dekagram (Dg.)
10 dekagrams	= 1 hektogram (Hg.)
10 hektograms	= 1 kilogram (Kg.)
1 kilogram	= 2.2 pounds.

Measures of Capacity or Volume

English

Liquid Measure

2 pints (pt.)	= 1 quart (qt.)
4 quarts (qt.)	= 1 gallon (gal.)
231 cu. in.	= 1 gallon (gal.)

Dry Measure

2 pints (pt.)	= 1 quart (qt.)
8 quarts (qt.)	= 1 peck (pk.)
4 pecks (pk.)	= 1 bushel (bu.)
2150.42 cu.in.	= 1 bushel (bu.)

Metric

10 milliliters (ml.)	= 1 centiliter (cl.)
10 centiliters	= 1 deciliter (dl.)
10 deciliters	= 1 liter (l.)
10 liters	= 1 dekaliter (Dl.)
10 dekaliters	= 1 hektoliter (Hl.)
10 hektoliters	= 1 kiloliter (Kl.)
1 liter	= about 1.1 liquid qt. .9 dry qt. 64 cu. in.
1 hektoliter	= about 2.8 bu.

Measures of Surface

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
$30\frac{1}{4}$ sq. yd. or $272\frac{1}{4}$ sq. ft. = 1 square rod (sq. rd.)

160 square rods = 1 acre (A.)
640 acres = 1 square mile (sq. mi.)
36 sq. mi. = a township (tp.)

Measures of Volume or Capacity

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord of 4 ft. wood

38 cubic feet (approximately) = 1 ton soft coal
$34\frac{1}{2}$ cubic feet (approximately) = 1 ton hard coal
1 cu. ft. = .8 bushel
1 cu. ft. = .63 heaped bushel
1 cu. ft. = .43 bu. of corn in ear

Measures of Time

60 seconds (sec.)	= 1 minute (min.)
60 minutes (min.)	= 1 hour (hr.)
24 hours (hr.)	= 1 day (da.)
7 days (da.)	= 1 week (wk.)
365 days	= 1 common year (yr.)
366 days	= 1 leap year
360 days	= 1 interest year
100 years	= 1 century
10 years	= 1 decade

Measures of Angles or Arcs

60 seconds (″)	= 1 minute (′)
60 minutes (′)	= 1 degree (°)
90 degrees (°)	= 1 quadrant
360 degrees (°)	= 1 circumference
π (pi)	= 3.1416 or $3\frac{1}{7}$

Century years divisible by 400 and other years divisible by 4 are leap years

Table of Equivalents Used in Recipes

3 teaspoonfuls (tsp.) = 1 tablespoonful (tbsp.)
4 tablespoonfuls (tbsp.) = $\frac{1}{4}$ cup or $\frac{1}{2}$ gill.

2 gills	= 1 cup	2 tbsp. sugar = 1 oz.
2 cups	= 1 lb.	2 cups granulated sugar = 1 lb.
4 cups flour	= 1 lb.	2 cups solid butter = 1 lb.
3 cups meal	= 1 lb.	

Values Accurate Enough for Ordinary Computation

1 ton hard coal	= $34\frac{1}{2}$ cu. ft.	1 meter	= 40 in.
1 ton soft coal	= 38 cu. ft.	1 decimeter	= 4 in.
1 cu. ft.	= .8 bu. level full	1 centimeter	= .4 in.
2747.07 cu. in.	= 1 heaped bushel	1 kilometer	= .6 mi.
4000 cu. in.	= 1 bu. of ear corn	1 liter	= 64 cu. in.
$7\frac{1}{2}$ gal.	= 1 cu. ft.	1 liter	= 1.1 liquid qt.
1 gal. water	= $8\frac{1}{3}$ lb.	1 hektoliter	= 2.8 bu.
$31\frac{1}{2}$ gal.	= 1 barrel (bbl.)	1 gram	= .035 oz.
[illegible] lb.	= 1 bbl. of flour	1 kilogram	= 2.2 lb.

Weights per Bushel

In estimating crop production and values, the United States Bureau of Crop Estimates regards the bushel as a definite weight instead of a definite volume. These are the bushel weights used for 16 crops:

Wheat, potatoes, clover and alfalfa seed	60 lb.	Corn in ear	70 lb.
Shelled corn, rye, kafir corn	56 lb.	Onions	57 lb.
Sweet potatoes, turnips	55 lb.	Timothy seed	45 lb.
Barley, buckwheat, apples, peaches	48 lb.	Oats	32 lb.

Condensed Multiplication and Division Tables to 12's

1	2	3	4	5	6	7	8	9	10	11	12
2	4										
3	6	9									
4	8	12	16								
5	10	15	20	25							
6	12	18	24	30	36						
7	14	21	28	35	42	49					
8	16	24	32	40	48	56	64				
9	18	27	36	45	54	63	72	81			
10	20	30	40	50	60	70	90	90	100		
11	22	33	44	55	66	77	88	99	110	121	
12	24	36	48	60	72	84	96	108	120	132	144
1's	2's	3's	4's	5's	6's	7's	8's	9's	10's	11's	12's

To use as a multiplication table, read to the right to the end of the line and then down; thus, $3 \times 2 = 6$, $3 \times 3 = 9$ end of line; then down $3 \times 4 = 12$, $3 \times 5 = 15$, etc. To use as a division table, read up to the top of the column; 4's in 48, 12; 4's in 44, 11; and so on to 4's in 16; then to the left 4's in 12, 3; 4's in 8, 2.

ANSWERS

Answers to all examples and to certain problems are omitted from this book.

Page 14. **4.** (1) \$19.506; (2) \$2.59 less; (3) 45.2%, 51.2%. **5.** (1) 1.88+ lb.; (2) 22.5 lb., 3.21+ lb.

Page 15. **6.** (1) Last ? 3,360,213,000 bu.; (4) 45.02%; (6) 38.4%.

Page 17. **6.** \$137.76. **7.** 110 lb. **8.** Total balance, \$924.94.

Page 19. **1.** (1) \$89.65; (2) \$3.70.

Page 24. **4.** \$14.50. **5.** 100, 16¢ rem. **6.** \$51. **7.** 9+%. **8.** 10¢. **9.** 25%. **10.** 80 mi. **11.** \$.009. **12.** 46.2+%, 48.5%, 5.2+%.

Page 25. **13.** 1620. **14.** \$2980.53. **15.** 29.3−%. **16.** 180%. **17.** 35.6%. **18.** 13.43+ mi. **19.** 2212.455 mi. **20.** 119.8+ mi.

Page 26. **1.** 934,562,300 lb. **2.** 1918 was 86.3% of 1917 and 79.9−% of 1916. **3.** \$56,073,738. **4.** 1,246,083,066.

Page 27. **12.** \$471.795.

Page 28. **14.** 37.07+ mi. **15.** 2 mi. **16.** 8.4%. **17.** \$1000. **18.** 45 in. **19.** $3\frac{8}{9}$ yd. **20.** \$212.50.

Page 29. **21.** (2) 15.98+%; (4) Boston is 12.819% better than N. Y.; (5) Dallas is 2.463% better than Atlanta, Kansas City is .235% better than St. Louis.

Page 30. **22.** 9.6¢. **23.** 10.2+%. **24.** (1) Total for the week, \$12,834.70; (3) \$755.52. **25.** 32. **26.** \$4165.20.

Page 64. **4.** \$111.18.

Page 65. **5.** Disct. \$20.66. **6.** Disct. \$46.58. **8.** (3) $58\frac{7}{8}$¢; (4) \$3392.

Page 70. **1.** 14.44%. **2.** (2) 8.8+%.

Page 71. (3) 11.24, 1124+%. (5) 65.7+%. **3.** (1) 17.1−%; (2) 20.6+%. **4.** 16.6+%. **5.** 1.4−% too high. **6.** .99+% too high. **7.** 26%.

Page 72. **8.** 7.5+%. **9.** \$650,097,380.50. **10.** (2) 12.6+%; (3) 16.4+%; (4) \$1,288,500,000 nearly.

Page 73. **12.** (1) 12.17¢; (2) 12; (3) 3.04+¢. **13.** .08+ yd. 100 yd. dash is 1.24+% faster.

Page 74. **1.** 120 A. **2.** $62\frac{1}{2}$%. **3.** Woodland $8\frac{1}{3}$%, wheat $16\frac{2}{3}$%, oats $16\frac{2}{3}$%, corn $15\frac{5}{8}$%, timothy $6\frac{1}{4}$%, red clover $10\frac{5}{12}$%, pasture $16\frac{2}{3}$%, alfalfa $3\frac{1}{8}$%. **4.** $4\frac{1}{6}$%. **5.** $2\frac{1}{12}$%.

Page 77. **8.** \$750 loss. **9.** $42\frac{6}{7}$%, 30%. **10.** 10%. **11.** .43+ ton. **12.** $12\frac{1}{2}$%. **14.** $46\frac{2}{3}$%. **15.** $12\frac{1}{2}$%. **16.** \$64.29. **17.** \$5.25. **18.** 14+%.

Page 78. **1.** \$18,961.25. **2.** \$890.90. **3.** 5%. **4.** \$19,260.

Page 79. **5.** 23.3−¢. **6.** \$37,370.58. **7.** \$19.30, \$1241.37. **8.** 52.4+¢. **9.** 74.4+¢.

Page 80. **7.** 800. **8.** 940. **9.** \$805 gain.

Page 83. **4.** \$4. **5.** \$342. **6.** The latter, \$2. **7.** \$200. **8.** 25.7+%. **9.** 56−%, 35.875%. **10.** 50%. **11.** \$300.98.

Page 91. **6.** 2224, 872. **7.** 29.1%. **8.** 43.5%, 50.7−%, 5.8+%.

Page 92. **9.** 84.2%. **11.** 285, 1254. **12.** \$1,246,000,000. **13.** (1) 40,000; (2) 40.

Page 93. **15.** $81\frac{1}{9}$%.

Page 95. **19.** Germany .76, England 17.14, ratio 22.5+. **22.** 1,200,000.

Page 100. **13.** 52,800; 39,600.

Page 101. **14.** 96−%. **15.** (1) $52.04; (2) $1302.58. **16.** (1) $77.29; (2) 1.48+.

Page 103. **2.** $5.603 state, $27.153 school, $66.374 city, $99.13 total. **3.** $8000.

Page 104. **4.** 12½ mills. **1.** B $250, D $225, S $175. **2.** 70%, 77⅞%.

Page 105. **3.** $214.38. **4.** $88.50, $84, $79.50.

Page 106. **1.** $2,664,865. **2.** $14,208. **3.** $754,400. **4.** $14,400, 5.3−%. **5.** $4801.25, $6401.67.

Page 111. **8.** $42.13. **9.** $50.75.

Page 127. **1.** 28¼ sq. ft. **2.** 25 A. **3.** 42 A. **4.** 275 A. **5.** 15 A. **6.** 9 A.

Page 133. **1.** 72 sq. in. **2.** 16π sq. ft. (Answers often may be expressed in this form for the sake of convenience.) **3.** 10.2994 sq. ft. **4.** 54π sq. ft. **5.** $218.17. **6.** 2π ft. **7.** Waste 7.7256 sq. in. **8.** 420.2− ft. **9.** 22π ft. **10.** 1120+. **11.** 27.3+%.

Page 138. **10.** $809.99, counting 2150.42 cu. in. to a bushel. **11.** 20.869+ tons, 521.7+ bu. **13.** 1000 cu. ft. **14.** 200 cu. ft. **15.** 3216 cu. ft. **16.** 1416.3− bu., counting 1 cu. ft. = .8 bu.

Page 140. **9.** $\frac{63}{8}\pi$ cu. in. **10.** 80π cu. in. **11.** 28.03− cu. in. **12.** 9.18 gal.

Page 141. **8.** $7.54. **9.** 35.95+ sq. ft. **1.** 13.571+. **2.** $10.86. **3.** 13.5+ sq. ft. **4.** 31.75− sq. ft. **5.** $27.54. **6.** 9.5+ in. **7.** 424.1+ gal. **8.** 2.45 gal.

Page 143. **1.** 32.7−%. **2.** 33⅓%. **3.** 30.7+%. **5.** 38.9−%. **6.** 25.6+%. **7.** $8.10. **8.** $5. **9.** 80%, 44⅘%.

Page 144. **10.** $400. **11.** 16⅔%. **12.** 33⅓%. **13.** 34+%. **14.** $171.53. **15.** $800. **16.** $45.75. **17.** $210.33.

Page 145. **18.** $1274.40. **19.** 12.17%. **20.** $63. **21.** $158.67, 4.41−%.

Page 176. **12.** 117.16 mi. **13.** 4.9+ mi. **14.** 25 mi.

Page 177. **15.** 75.6− ft. **17.** (1) 15 ft.; (2) 16½ ft.; (3) 1617 sq. ft. **18.** 2525 bd. ft.

Page 180. **2.** 440. **3.** 25%. **4.** $4.25. **5.** $1.00. **6.** 172. **7.** $8,738,138.43.

Page 184. **3.** 160 rd. **4.** 192 sq. ft. **5.** 16 ft. **6.** 144 sq. ft. **7.** 60 sq. in., 34.3 in. **8.** 6,283,200 sq. mi. **9.** 201,062,400 sq. mi.

Page 187. **1.** 537.6 bu. **2.** 21.7+ tons. **3.** 6361.7+ cu. ft. **4.** 324π cu. ft. **5.** Lack 4.81 cu. in. of 1 gal. **8.** 37. **9.** 4500π gal.

Page 188. **10.** 218.6+ sq. ft. **11.** 50 sq. in. **12.** (1) 45.3 ft., 102.6 ft.; (2) 180 sq. ft.; (3) 15%. **13.** 10.3+ ft., 61.8+ sq. ft. **14.** 12,108. **15.** 10 ft.

Page 189. **1.** 21.2+ tons. **2.** 172− days. **3.** 20. **4.** 30.

Page 191. **1.** 17,176.7 gal. **2.** 4.6+ hr. **3.** 60− gal. **4.** .00737 mill, 1356+ gal. **5.** 139+ gal., 38069.5 million. **6.** 37.4+¢. **7.** 13,757+ tons, 1748+ tons. 1491+ tons.

Page 199. **8.** $581.47. **9.** 6.8+%. **10.** .01+%.

Page 200. **11.** $1,941,062+. **13.** $15,924,825,161.

Page 202. **1.** 10%. **2.** 25.9+%. **3.** 8.1+%.

Page 203. **5.** Apples $1.50 better. The walnuts yielded 32% greater rate of profit. **6.** 18¾¢ per can, 25.3+%. **7.** 154+%. **8.** $3.865+. **9.** $1645.80.

Page 205. **1.** $20.83.

Page 207. **2.** 21 bbl., 7 cu. yd., 10 cu. yd. **3.** 38 bbl., 6 cu. yd. **4.** 117 sacks, 9 cu. yd., 13 cu. yd. **5.** 45 sacks, 3 cu. yd., 3 cu. yd. **6.** $1050, $260, $336.96. **7.** $1336.50, $534.60, $1069.20.

Page 208. **1.** $66,018− per mi. **2.** 79. **3.** 34.7−%. **4.** $.665+.

Page 209. **5.** $176.40. **6.** 27¢. **7.** $63.88. **8.** $27.76. **9.** $.937+. **10.** $2.487. **11.** Yes. **12.** $.597+ per bu.

Page 210. **14.** Full car rate is $40.96 better. **15.** $6820. **1.** $3,000,000. **2.** $3,750,000. **3.** 5,000,000.

Page 211. **4.** 25,097.

Page 212. **7.** All water route $1.38 per 100 lb. cheaper than part water. All water route $1.538 per 100 lb. cheaper than all rail. Part water route $.158 per 100 lb. cheaper than all rail.

Page 213. **1.** $5.87.

Page 214. **2.** $3.87. **3.** $7.14.

Page 215. **1.** 35¢. **2.** 44¢. **3.** 41¢. **1.** No difference. **2.** Express, 8¢.

Page 229. **13.** $5.13, 171 mi. **14.** $15.76, 526 mi. **15.** $10.40, 289 mi.

Page 230. **18.** 172 mi. **19.** Speed was about 21 mi. per hr. less. **20.** 181+ mi. **21.** 120.9+ mi. **22.** (1) $11\frac{1}{2}$ sec.; (2) 1 hr. 13 min. $25\frac{1}{2}$ sec.; (3) 108 mi., 102.9+ mi.

Page 231. **1.** $211.69. **2.** $123.58. **3.** $4127.27.

Page 233. **8.** 47.4−%. **9.** 200%. **11.** 20%. **12.** 100%.

Page 234. **1.** 33.7−%. **2.** 81.5+%. **3.** $3.31. **4.** (1) 380.1735; (2) $1960.76; (3) $479.86; (4) $9762.47; (5) $12,203.10; (6) $21,965.57.

Page 235. **1.** $226.50. **2.** $4.53. **3.** $87.96. **4.** $1.759. **5.** $138.54. **6.** $2.77. **7.** 59.7+%. **8.** 157.5+%.

Page 237. **II.** (1) $585; (3) $31. **III.** 33−%.

Page 238. **IV.** (1) 3640; (3) $10\frac{2}{3}$ oz.

Page 239. **V.** $.0705. **I.** (1) .97 lb., 1.58 lb., 3.63 lb., 4.83 lb. **II.** (1) first; (2) last; (3) second.

Page 240. (5) $1.70 profit, not counting labor cost. **IV.** (2) 2 lb. shorts, $\frac{2}{3}$ lb. oilmeal.

Page 241. **VI.** (1) Gain 49¢ on each bu. fed; (2) Gain $392. **VII.** (1) $3.32; (2) 40.

Page 242. **I.** (1) 48; (2) 175; (4) 102−%, 70%, etc.

Page 244. **III.** (1) $45.15.

Page 245. **IV.** (1) 8 ft. $7\frac{1}{2}$ in.; (2) 492 bd. ft.; (4) $8.20. **1.** 19. **2.** $700. **3.** 60¢, 75¢, $1.25. **4.** 34%. **5.** Lacked $1\frac{1}{3}$ oz. on each piece of being accurate.

Page 246. **6.** 10¢. **7.** $132. **8.** 21¢. **9.** 5.3−%. **10.** 45,000,000.

Page 266. **7.** $1310.33.

Page 267. **8.** $299.10. **9.** $401.64. **10.** $2506.42. **11.** (1) $2.15, $300.85; (2) $13.40, $1204.60; (3) $14.53, $2005.47; (4) $2.45, $99.55; (5) $59.55, $4000.45. **13.** $1971.60.

Page 269. **2.** $138.36.

Page 270. **4.** $103.52. **5.** $2.71.

Page 272. **2.** $16.48.

Page 274. **1.** $134.39. **6.** Latter, $3.86 more. **7.** $1689.89.

Page 284. **7.** $98,125. **8.** $10,825. **9.** $4325. **11.** $375. **12.** $1075.

Page 285. **2.** $80. **3.** 8.69%. **4.** $6\frac{2}{3}$%. **5.** $200.

Page 288. **8.** 86¢. **9.** $268.08. **10.** $9812.50.

Page 289. **12.** 54, $64.45 over. **13.** 1, $18.29 over.

Page 291. **10.** 5.37%. **11.** 4.66%. **12.** 2.99%.

Page 293. **1.** 9.87+%. **2.** $21.71. **4.** $78.90, $347.35.

Page 294. **1.** First, $7 better. **2.** $582.97 more. **3.** $31.38. **4.** Lose $16.60 **5.** 1st, $75; 2nd, $68.75 yearly.

Page 295. **1.** 2%, $33\frac{1}{3}$%. **3.** (1) 8.69%; (2) $750; (3) $91; (4) 21.76%; (5) $7\frac{1}{2}$%. **4.** $1338.50.